Board of Public Utilities
of the
City of Springfield, Missouri

One Million Gallon Booster II Elevated Composite Water Storage Tank

Competitive Request for Proposal
RFP 0000052882

August 2017

SECTION 00007
SEALS PAGE

Only the specification sections enumerated below have been prepared under my direct supervision and the seal below applies only to those sections.

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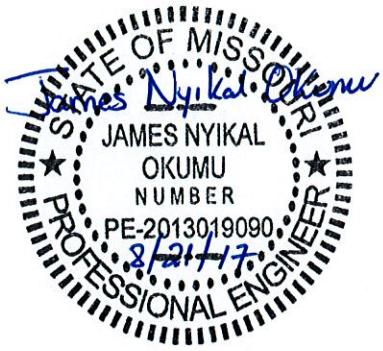
13210 COMPOSITE ELEVATED TANK
15110 VALVES
15140 PIPES AND PIPE FITTINGS
15430 EMERGENCY EYE/FACE WASH AND SHOWER EQUIPMENT



END OF SECTION

SECTION 00010
INDEX TO CONTRACT DOCUMENTS

INDEX TO CONTRACT DOCUMENTS (Continued)

END OF SECTION

SECTION 00015
DRAWING LIST

The City Utilities drawing numbers listed below are a part of this Contract and attached by reference.

Drawing No. 76,329-D, Sheets C0, C1, C2, C3, E0, E1, E2, E3, E4, E5, E6, E7, E8, and E9

The drawings can be viewed and downloaded by navigating to the following Website and searching by bidding event number or name:

https://www.cityutilities.net/bids

or go to

www.cityutilities.net and follow these links:

- For Business (top of page)
- Purchasing
- Bidding Opportunities
- Current Bidding Events & Awards Results
- All CU Bidding Opportunities
- **0000052882**

You will have access to open, print and/or save pdf file(s).

END OF SECTION

SECTION 00100
INVITATION TO BID

The Board of Public Utilities of the City of Springfield, Missouri, (City Utilities) invites you to submit a proposal for the work described below. Contract Documents are available online as instructed in *Section B* of this document. Questions should be directed to:

Erica Sutton		Purchasing Department
Buyer I		City Utilities of Springfield, Missouri
417-831-8496	**- OR -**	[P] (417) 831-8363
417-831-8377		[F] (417) 831-8377
erica.sutton@cityutilities.net		[E] purchasing@cityutilities.net

A. RFP REGISTRATION

City Utilities requests that firms interested in this RFP contact the Buyer listed in the previous section and register as a bidder. City Utilities will keep contact information in a log and notify those that have registered when addenda are issued. Bidders are advised that addenda containing additional information and instruction pertaining to this RFP may be issued at any time. It is the bidder's responsibility to verify, prior to the stated proposal opening date/time, as to whether addenda have been issued.

B. SUPPLEMENTAL PROCUREMENT DOCUMENTS

Procurement Documents for **RFP 0000052882**, complete with detailed specifications, drawings and bid form, can be viewed and downloaded by navigating to the following Website and searching by bidding event number or name:

https://www.cityutilities.net/bids

or go to

www.cityutilities.net and follow these links:
- For Business (top of page)
- Purchasing
- Bidding Opportunities
- Current Bidding Events & Awards Results
- All CU Bidding Opportunities
- **0000052882**

You will have access to open, print and/or save pdf file(s).

C. SUMMARY SCOPE OF WORK

The work includes, but is not limited to, the following:

The design, construction, testing and commissioning of a 1 Million Gallon Composite Elevated Tank and related work including foundation, painting, piping, electrical, hydrodynamic mixing system, additional structural floor, and appurtenances as shown on the drawings and in accordance with these specifications.

The site will also have a structure adjacent to the tank to feed chlorine gas as a re-chlorination point in the distribution system. Contractor will perform work as indicated in the specifications and drawings. City Utilities personnel will connect the chorine system and provide materials as noted in the specifications and drawings.

D. PRE-PROPOSAL CONFERENCE *** **MANDATORY** ***

Pre-bid conferences will be held **September 12, 2017 at 10:00 A.M. CDT**, and **September 14, 2017 at 2:00 P.M. CDT** at the City Utilities Fulbright Water Treatment Plant conference room located at 3920 N Farmer (Located off Old Highway 13, North of Norton Rd), Springfield, MO 65803. Each pre-bid conference will be followed by a site visit to the construction site. **Attendance at one of the pre-bid conference options is mandatory**. Please RSVP by contacting Erica Sutton at 417-831-8496 or erica.sutton@cityutilities.net.

E. PROPOSAL OPENING

All proposals must be in the hands of the Purchasing Agent of City Utilities, per one of the approved submittal methods provided in the below RFP Section 00100-F (Proposal Submittal Methods), by the Proposal Opening date and time, which is **October 4, 2017 at 2:00 PM (CST)**. Any proposal received after such date and time will be rejected.

Proposals will not be publicly opened or read since the selection process will be determined based upon competitive negotiated procurement procedures for proposals as described in this RFP.

All proposals shall be irrevocable for ninety (90) days after the time for opening of proposals.

F. PROPOSAL SUBMITTAL METHODS

FAX AND EMAIL RESPONSES ARE NOT ACCEPTABLE. All proposals must be received by CU Purchasing by the opening date and time stated in this document. The method of submittal is at the sole discretion and risk of the Contractor. Preparation for any submittal method should be taken well enough in advance of the posted opening date and time to allow for unexpected issues. City Utilities is not responsible for submittal failures of any kind- electronic or otherwise. Contractors utilizing CU's Electronic Bid Attachment Tool (EBAT) should verify that any attachment meets the posted electronic file type and size requirements. Contractors mailing proposals or having proposals delivered should allow sufficient time to insure receipt by the due date and time specified. Mail, express mail and delivered responses must be sealed in an opaque envelope or package and should include one set of original documents plus two (2) copies (marked appropriately as "Original" and "Copy").

****** Users may ask for additional copies based upon their evaluation needs ******

****** Proposals in response to this RFP may be submitted by any of the methods listed below ******

1. **Electronic Bid Attachment Tool (EBAT)**

   Open to all bidders – NO REGISTRATION OR LOGIN REQUIRED. Proposals submitted via EBAT must be an approved electronic file type (PDF, DOC, XLS, TIF or ZIP) and have a total attachment size that does not exceed 50-MB.

   www.cityutilities.net/EBAT

   OR GO TO www.cityutilities.net and click on the following links:

   - For Business (at top of page)
   - Purchasing
   - Bidding Opportunities
   - Electronic Bid Attachment Tool (EBAT)

2. **Mail / Express Mail / Hand Deliver**

   Proposals submitted via mail/express mail or hand delivered shall be sealed in an opaque envelope or package that is clearly marked on the outside with the RFP number and opening date/time. Proposals are to be addressed to:

   City Utilities of Springfield, Missouri
   Purchasing Manager
   301 East Central (65802)
   P.O. Box 551
   Springfield, MO 65801-0551

3. **PeopleSoft Registered On-Line Bidding System (Legacy system – enrollment closed)**

G. SCHEDULE OF EVENTS

Event	Date
1. RFP Distribution	08/21/2017
2. Proposal Due Date	10/04/2017
3. Target Date for Review of Proposals	10/19/2017
4. Anticipated decision and selection of Vendor	10/26/2017
5. Anticipated commencement date of work	10/30/2017

END OF SECTION

SECTION 00200
INSTRUCTIONS TO BIDDERS

A. INTERPRETATION TO BIDDER

A prospective bidder who is in doubt as to the meaning of any part of the Contract Documents or any addenda thereto, may submit a written request for interpretation. Such requests shall be directed to the CU Purchasing representative identified in this document and directly to the CU Purchasing department at one of the following options:

Purchasing Department
City Utilities of Springfield, Missouri
[P] (417) 831-8363
[F] (417) 831-8377
[E] purchasing@cityutilities.net
301 East Central (65802)
P.O. Box 551
Springfield, MO 65801-0551

Any such interpretation will be made by written addendum. City Utilities will not be responsible for any explanation or interpretation of proposed documents other than by such an addendum. An oral permission or interpretation has no legal force, authority, or effect. Any addenda must be acknowledged in the proposal and will become a part of the Contract Documents. Failure to acknowledge in the proposal all addenda issued may constitute grounds for rejection of that proposal.

All requests for interpretations must be received in the Purchasing Department no later than **five calendar days prior to the bid opening date.** Requests received after that date will not be answered. Persons submitting a request will be responsible for its prompt delivery.

The terms “bid” and “proposal” are synonymous when used in this document.

B. GUARANTY

Each bid must be accompanied by a Bid Bond with an adequate surety, naming the Board of Public Utilities of Springfield, Missouri, as obligee, in a penal sum equal to five percent of the maximum bid price excluding options, or in lieu thereof, a certified check drawn on a Federally insured banking institution, payable to the Board in the same amount as the penalty of the Bond. The Bond or Check shall be conditioned that should a bidder, after award, fail to enter into a contract, then the entire amount of the Bond or Check shall become the property of the Board, or the Board shall be entitled to recover the entire penal sum of the Bond or Check without further proof of damage. Bid Checks will be returned to all unsuccessful bidders within a period of thirty days following contract execution.

C. SIGNATURE ON PROPOSALS

Each proposal must be signed in ink and include the full business address of the bidder. Proposals by partnerships must be signed in the partnership name by one or more of the general partners. Proposals by a corporation must be signed by an officer of the corporation or other person authorized

to bind the corporation to the proposal. The names and titles of all persons signing shall be typed or printed below their signatures.

D. BIDDER'S RESPONSIBILITIES

By submitting a proposal, each bidder represents that he is familiar with, assumes full responsibility for having familiarized himself with, and will comply with the content of the Contract Documents, the nature of the work, the locality, permits, licenses, and all local conditions, together with all applicable Federal, State, and local laws and ordinances.

E. MARKING AND MAILING BIDS

All proposals shall be sealed in an opaque envelope or package that is clearly marked on the outside with RFP 0000052882 and the bid opening date and time provided in Section 00100 (Invitation to Bid) of this RFP. Proposals are to be addressed to:

City Utilities of Springfield, Missouri
Purchasing Manager
301 East Central (65802)
P.O. Box 551
Springfield, MO 65801-0551

All bids, whether mailed or hand delivered, must be received by Purchasing at the above address by the date and time stated for the bid opening. Method of delivery is at the sole discretion and risk of the Contractor. Contractors mailing their bids should allow sufficient time to ensure receipt of their bids by the date and time specified. If mailing your response, provide two copies and mark the appropriate versions as "Original" and "Copy."

F. PROPRIETARY INFORMATION

Proprietary Information: Pursuant to Section 610.021.15 R.S.Mo, City Utilities may close records that relate to scientific and technological innovations in which the owner has a proprietary interest. If you plan to submit such information with your bid and wish to keep it confidential, please submit it in a separate envelope with your bid and clearly mark it "CONFIDENTIAL AND PROPRIETARY SCIENTIFIC AND/OR TECHNOLOGICAL INFORMATION." This information must not include prices, terms and conditions, Bidder's qualifications, or any other information submitted in response to this Request for Proposal that is not exempted under Section 610.021.15. Any information that does not fall within Section 610.021.15 or other exception to Missouri's Sunshine Law (Section 610.021 R.S.Mo., et seq.) is a public record and will be disclosed upon request.

G. ERRORS PROPOSALS

Each bidder must carefully examine his bid prior to submission. Failure to do so is at the bidder's risk. He is responsible for any errors therein. Claim of oversight is not a basis for permitting withdrawal of a bid after opening. There shall be no erasures in any bid. Any changes must be made by striking the portion to be changed with the change noted above the deleted portion, followed by the bidder's initials and date.

H. PROPOSAL WITHDRAWAL

Proposals may be withdrawn at any time prior to the time for the opening of proposals.

I. EVALUATION AND SELECTION PROCESS

The proposal evaluation and selection process will be awarded under this Request for Proposal (RFP) based on competitive negotiated procurement procedures. Interviews, discussions, negotiations and a Best and Final Offer (BAFO) may be held only with selected firms from those firms who meet City Utilities requirements and fall within the competitive range as determined by City Utilities. City Utilities reserves the right to limit negotiations to those proposals which received the highest rankings during the initial evaluation phase. However, City Utilities reserves the right to award a contract to a firm solely on the basis of this initial proposal submitted and without any further interview, discussions and negotiation.

If City Utilities determines that the number of proposals that would otherwise be in the competitive range exceeds the number at which an efficient competition can be conducted, City Utilities may limit the number of proposals in the competitive range to the greatest number that will permit an efficient competition among the most highly rated proposals.

Each Proposer must comply with the requirements contained in the RFP. Deviation from the requirements will be evaluated but may, at the discretion of the Board of Public Utilities, result in rejection of a proposal.

The Board of Public Utilities will evaluate each proposal to determine which is the lowest and best (i.e., Best Value). The Board of Public Utilities reserves the right to waive informalities and to accept or reject any or all proposals submitted.

If City Utilities determines that a proposal has failed to meet an acceptable level on any factor listed below, then City Utilities may reject that proposal.

EVALUATION CRITERIA

In evaluating the proposals, City Utilities will use the following evaluation factors to determine the lowest and best proposal. Deviation from the requirements will be evaluated, but may, in the discretion of the Board of Public Utilities, result in rejection of a proposal.

Evaluation Factors

- Cost (80%)
- Adherence to RFP requirements, including responses to Section III-C, *Questions/Requests for Submittals* (20%)

Bidders should consider these factors when preparing their proposals and should provide a specific response to each of the evaluation factors.

Based on the evaluation process described, the Evaluation Committee comprised of City Utilities employees, will review the proposals.

J. CONDITIONS AFFECTING THE WORK

Each bidder should take such steps as he thinks necessary to ascertain the nature and location of the work and any peculiar local conditions which can affect the work or its cost. Failure to do so will not relieve the bidder of his responsibility for proper estimation of the difficulty or cost of the work. City Utilities assumes no responsibility for any understanding or representation made by any person at any time, unless it is included in the Contract Documents, including addenda.

K. DIVERSITY

City Utilities of Springfield encourages prime and general contractors to consider certified DBE, WBE and MBE's for those construction contracts which have subcontracting opportunities.

L. SALES TAX EXEMPTION NOTICE

This is to notify Bidders that certain materials incorporated into the project are exempt from Missouri sales tax pursuant to the provisions of Section 144.062 R.S.Mo. The selected Contractor will receive a Project Exemption Certificate and a Missouri Tax Exemption letter from City Utilities to use in purchasing materials on a tax-free basis. It will be the contractor's responsibility to provide the documentation to any Subcontractor or Supplier. These documents will be used solely for purchase of materials being directly incorporated into or consumed in the construction of the work under this Agreement.

M. REQUIRED AFFIDAVIT FOR CONTRACTS OVER $5,000 DOLLARS (US)

Company shall comply with the provisions of Section 285.525 through 285.550 R.S.Mo. Contract award is contingent on Company providing an acceptable notarized affidavit stating:

1. that Company is enrolled in and participates in a federal work authorization program with respect to the employees working in connection with the contracted services; and

2. that Company does not knowingly employ any person who is an unauthorized alien in connection the contracted services.

Copy of the affidavit can be found and downloaded at CU website:
https://www.cityutilities.net/wp-content/uploads/purchasing-complianceaffidavit.pdf

Additionally, Company must provide documentation evidencing current enrollment in a federal work authorization program (e.g. electronic signature page from E-Verify program's Memo of Understanding (MOU).

N. TRANSIENT EMPLOYER LAW

Any nonresident or foreign companies who employ people in Missouri must provide:

1. A certificate from the Missouri Director of Revenue showing compliance with the Transient Employer Law (285.230 R.S.Mo. et seq.); or

2. Proof of exemption from Section 285.230 R.S.Mo.

A Certificate of Compliance or proof of exemption must be submitted to City Utilities in regards to the transient employer law. Questions? See http://dor.mo.gov/business/register/ or call (573) 751-0459.

O. OSHA COMPLIANCE

Contractor shall comply with all applicable OSHA rules.

P. HARD HAT COMPLIANCE

Contractor shall be responsible for strictly adhering to City Utilities hard hat policy. Additionally, no on-site work may be performed unless a hard hat is worn.

Q. OSHA CONSTRUCTION SAFETY AND HEALTH TRAINING

CONTRACTOR shall provide a ten-hour Occupational Safety and Health Administration (OSHA) construction safety program for its onsite employees, which includes a course in construction safety and health approved by OSHA or a similar program approved by the department which is a least as stringent as an approved OSHA program, unless such employees have previously completed the required program. All employees are required to complete the program within sixty days of beginning work on such construction project. An employee found on a work site without documentation of the successful completion of the required training shall be afforded twenty days to produce such documentation before being subject to removal form the project. This provision is subject to and Contractor shall comply with all requirements of Section 292.675 R.S.Mo.

R. PREVAILING WAGE REQUIREMENT

This contract is subject to the prevailing wage law. It is agreed that all workman employed by Contractor and any subcontractor under him will be paid not less than the prevailing wage as determined by Missouri Department of Labor and Industrial Relations and Annual Wage Order, and any amendments, attached hereto and made a part hereof. Contractor shall forfeit as a penalty to the Board of Public Utilities of Springfield, Missouri, $100.00 for each workman employed, for each calendar day or portion thereof, such workman is paid less than said wage for work done pursuant to this Contract. It is agreed that the Contract or sums payable to Contractor for the performance of this agreement are not subject to increase as a result of any change in the amount of such wage determined pursuant to Section 290.210 et. seq. R.S.Mo., Prevailing wages for renewal years will be the then current Annual Wage Order in effect at the time of renewal and any amendments, if applicable.

Recognized **Annual Wage Order (AWO) 24, Effective June 7, 2017**

Copies of the referenced AWO are available at the following website or upon request: https://www.cityutilities.net/wp-content/uploads/purchasing-annualwageorder.pdf

The Contractor shall be required to complete an affidavit stating that he or she has complied with the prevailing wage law prior to final payment by City Utilities. This affidavit is available at the following website or upon request: https://labor.mo.gov/sites/default/files/pubs_forms/PW-4-AI.pdf.

S. PROMPT PAYMENT

Contractor agrees to pay each Subcontractor under each Purchase Order/Agreement for satisfactory performance of its contract in accordance with Section 34.057 R. S. Mo.

T. PERFORMANCE AND PAYMENT BOND

Successful Bidder shall furnish a Performance and Payment Bond as security for the faithful performance and payment of all their obligations under the Purchase Order (Contract) and Section 107.170 R.S.Mo. The Bond shall be in the amount of the bid and in the form provided herein and with such sureties as are licensed to conduct business in the State of Missouri and are named in the current list of "Surety Companies acceptable on Federal Bonds" as published in the Federal Register by the Audit Staff Bureau of Accounts, U.S. Treasury Department, and as acceptable reinsuring companies as published in the Federal Register by the department of the Treasury.

If the surety on any Bond furnished by Bidder (Contractor) is declared bankrupt or becomes insolvent or its rights to do business is terminated or revoked in any state where any of the project is located, bidder (Contractor) shall within five days thereafter substitute another bond and surety, both of which shall be acceptable to City Utilities.

The bond shall be filed with City Utilities within ten days unless superseded in the Request to Bid documents. The Bond shall be approved prior to the start of work.

U. NOTIFICATION OF EMPLOYEE RIGHTS UNDER FEDERAL LABOR LAWS

To the extent that is applicable, Contractor is subject to all requirements of 29 CFR – Part 471.

V. The general foreman shall be fluent in English or, if he is not, then the CONTRACTOR shall, at its expense, provide a translator who is. The translator shall have knowledge and experience regarding the equipment, materials, methods and techniques needed to perform the Work. It is the CONTRACTOR'S responsibility to ensure that there are no miscommunications due to language.

W. STANDARD BIDDING INSTRUCTIONS AND GENERAL CONDITIONS

Any order arising from this Bidding Event will be subject to the following **WHICH ARE INCORPORATED HEREIN BY REFERENCE**:

- *City Utilities of Springfield Missouri Standard Bidding Instructions* (Rev 7-2017)
- *City Utilities of Springfield Missouri General Conditions* (Rev 8-2016)

The referenced documents are available at https://www.cityutilities.net/purchasing/general/ or upon request.

END OF SECTION

SECTION 00410
BID FORM

A. NAME OF BIDDER:

1. [To be used if Contractor is a corporation]
_____, a corporation organized and existing under the laws of the State of _____, with its principal office and place of business in the City of _____, with the address of _____
_____.

2. [To be used if Contractor is a partnership]
_____, a partnership consisting of _____ and _____ of the City of,_____ with the address of _____.

3. [To be used by an individual or sole trader]
_____doing business as _____, of the City of_____
_____, with the address of _____
_____.

B. TO:
BOARD OF PUBLIC UTILITIES
CITY OF SPRINGFIELD, MISSOURI

The undersigned proposes to furnish at his sole risk, cost, and expense all labor, tools, equipment, materials, supplies, facilities, transportation and other means necessary to perform the work as set out in RFP 0000052882, in strict accordance therewith, for the price(s) reflected below:

1. BASE BID ITEM

The complete design, construction, testing and commissioning of a One Million Gallon Composite Elevated Tank and any/all related work as detailed in this RFP including foundation, painting, piping, electrical, hydrodynamic mixing system, adjacent re-chlorination point structure and any/all appurtenances.

Base Bid Lump Sum Price: US $_____

Bidders shall base their bid on the recommendations provided by Palmerton & Parrish, Inc. report (Appendix A) dated April 28, 2017 in section *9.2 Shallow Foundations on Natural Soils.* If changes must be made to the foundation design, a change order will be issued to the awarded contractor

2. ALTERNATE BID (ADD/DEDUCT)

Owner has solely specified a Tideflex hydrodynamic mixing system to be included in the base bid. Contractor may provide alternative hydrodynamic mixing system that meets or exceeds the specified system as per specification section 11268. Alternate bid amount shall be an adder or deduct to the base bid only if proposing an alternate mixing system. Contractor providing an alternate system shall in their submittals proof that the system will perform as well or better than the specified system.

Alternate Bid (Add/Deduct): US $_____

3. UNIT PRICE ITEMS

A. Rock Excavation: Removal of limestone from below the foundation bearing elevation to provide more uniformity in foundation support. Depth of removal shall be determined by joint collaboration between the foundation tank designer and Geotechnical Engineer. Limestone shall be removed by mechanical breaker. All chert or clay seams or layers interbedded in the limestone will be paid for as rock excavation. The volume of rock removed shall be measured in the field by the Geotechnical Engineer. Pay lines for rock removal shall be no more than 6 inches below the authorized elevation of removal and no more than 6 inches beyond the horizontal limit of authorized removal. For the purpose of bid evaluation, the volume of rock removal listed below shall be included. Actual volume of rock removal will be more or less than listed below. Each bidder shall provide a unit price for rock removal.

VOLUME OF ROCK REMOVAL:

50 cubic yards x $_____ /cubic yard = $_____

B. Earth Excavation: Removal of Earth material as required to perform rock excavation described above. The volume of Earth removed shall be measured in the field by the Geotechnical Engineer. For the purpose of bid evaluation, the volume of Earth removal listed below shall be included. Actual volume of Earth removal will be more or less than listed below. Each bidder will provide a unit price for Earth removal.

VOLUME OF EARTH REMOVAL:

200 cubic yards x $_____/cubic yard = $_____

C. Rock Backfill: Rock backfill placed below foundation bearing elevation shall consist of crushed rock from limestone or dolomite material with maximum particle size no greater than 8 inches, but no smaller than 4 inches and well graded from maximum particle size to rock dust. Rock fill may be obtained from off site or produced from on-site rock excavation. Rock fill shall contain sufficient sand, gravel and rock fines to fill voids. The percent of material passing the #200 sieve shall not exceed 15%. Rock fill shall be placed in maximum 8 inch loose lifts and compacted by at least four (4) passes of a self-propelled vibratory roller with a minimum drum diameter of 42 inches. Each lift of rock fill shall be observed and approved by a qualified representative of the Geotechnical Engineer prior to placement of successive lifts. The volume of Rock Backfill shall be measured in the field by the Geotechnical Engineer. For the purpose of bid evaluation, the volume of rock fill listed below shall be included. Actual volume of rock fill will be more or less than listed below. Each bidder shall provide a unit price for rock backfill.

VOLUME OF ROCK BACKFILL:

100 cubic yards x $_____/cubic yard = $_____

D. Earth Backfill: Earth backfill shall consist of earth material classifying as CL, CH, GC, or SC and containing at least 35% rock fragments retained on the #4 sieve. Earth fill shall be placed in maximum 8 inch loose lifts and compacted to at least 95% of maximum Standard Proctor Density

(ASTM D698) within 0% to 4% above optimum for CH soil types and within 2% of optimum for remaining soil types. Earth fill shall be compacted using a self-propelled vibratory roller with a minimum drum diameter of 30 inches. Earth fill shall be free of organics, deleterious materials, and rock size greater than 6 inches. Compacted density and moisture content of each lift shall be determined to be in compliance with specifications by the Owner's testing agency prior to placement and compaction of subsequent lifts. The volume of Earth Backfill shall be measured in the field by the Geotechnical Engineer. For the purpose of bid evaluation, the volume of earth fill listed below shall be included. Actual volume of earth fill will be more or less than listed below. Each bidder shall provide a unit price for earth backfill.

VOLUME OF EARTH BACKFILL:

150 cubic yards x $_____/cubic yard = $_____

4. PAYMENT/PERFORMANCE BOND

The reasonable cost of a performance bond to cover performance, labor, and materials for the successful bidder will be paid by City Utilities. The amount to be paid will be the actual cost of the bond verified by the bonding company's invoice and will not exceed the amounts shown below:

Cost of required bond will be paid by City Utilities. The amount to be paid will be the actual cost of the bond verified by the bonding company's invoice and will not exceed the amounts quoted by the bidder:

- **Cost of a Performance Bond for total lump sum bid: $_____ (not to exceed)**
- **Cost of a Performance Bond per each additional $1,000.00: $_____ (not to exceed)**

C. QUESTIONS / REQUESTS FOR SUBMITTALS

Bidder shall include with submission of proposal sufficient and detailed responses to the following questions and/or requests for submittals. Responses should be submitted in a clear form that corresponds to the numbering format contained herein. Failure to provide this information as instructed may result in rejection of proposal:

******* CONTRACTOR'S QUALIFICATIONS / QUALITY ASSURANCE *******

Refer to RFP Section 13210, Sub-Section 1.05 (Quality Assurance) for experience, quality assurance and regulatory requirements.

1. How many years has your company been in business as a General Contractor in similar construction?

2. How many years has your company been in business under its present name? If applicable, list prior names.

3. Provide the total number of projects your company currently has under contract.

4. What is the dollar value of the projects your company currently has under contract?

5. Have you ever failed to complete a project? If yes, please explain in detail.

6. Has your company ever been involved in any litigation resulting from the construction of a project of similar type? If yes, please explain.

7. How many years' experience in composite tank design and construction does your company have?

8. Provide examples of at least five (5) composite elevated tanks of the same design, equal or greater capacity and constructed using forming details as described in this RFP that your company has designed, constructed and commissioned. Include contact information of tank owner and the year the project was completed.

9. Provide confirmation that the elevated tank design, concrete support structure construction and steel tank construction will be performed by the contractor submitting the proposal in response to this RFP and that these components **will not** be subcontracted.

10. Provide confirmation that the elevated tank painting will be performed by the contractor submitting the proposal. If a sub-contractor is to be used, they must have a minimum of five (5) years of experience painting elevated storage tanks. Provide references/projects of at least five (5) similar projects that sub-contractor has performed.

11. Provide the name(s) of the professional engineer(s) under direct full-time employment of the contractor submitting the proposal in response to this RFP that will be assigned to this project. Any engineer in this role must have a minimum of five (5) years cumulative experience in the design and construction of composite elevated tanks and be appropriately registered in the State of Missouri.

12. Provide confirmation that a qualified supervisor directly employed by the manufacturer will be on-site at all times during construction of the foundation, support structure and steel tank.

******* SAFETY AND LOSS CONTROL *******

13. List your firm's Interstate Experience Modification Rate (EMR) for the past three years. Use your intrastate EMR if not interstate rated. **Attach a signed and dated letter from your workers' compensation insurance carrier verifying your EMR.**

14. Provide your Standard Occupational Classification (SOC) number.

15. Provide your company's injury experience for the past three years using OSHA No. 300 logs (As an alternative, you may submit copies of your logs). The following items must be addressed:

    a. Number of OSHA recordable cases:
    b. Number of lost workday cases:
    c. Number of lost workdays:
    d. Number of restricted workday cases:
    e. Number of fatalities:
    f. Number of man-hours worked:

16. Has your organization been cited by OSHA in the last 5 years? If yes, include number and details of citations.

17. Will a full-time or part-time safety supervisor be utilized on this project? Please specify your normal practice for a project of this scope.

18. Does your organization conduct documented safety inspections? If yes, provide details including the frequency of the safety inspections, who conducts the inspections, etc.

19. Do you have a home office safety representative who visits and audits the job? If yes, provide contact information (name, title, phone, fax, email).

20. How frequently will the safety representative visit the project?

21. Does the safety representative have the authority to make corrections?

22. To whom does the safety representative report?

23. Do you require that documented safety meetings be held for:

    a. Resident Superintendent? (Yes / No / Frequency)
    b. Employees? (Yes / No / Frequency)
    c. New Hires? (Yes / No / Frequency)
    d. Subcontractors? (Yes / No / Frequency)

24. Do you currently maintain a company program in compliance with applicable state "Right to Know" laws and OSHA Hazard Communication Standard for construction?

25. Submit copies of all reports of OSHA inspections of your firm for the last three years.

26. List all accidents in which your company was involved in the last ten (10) years that resulted in death or serious personnel injury. State the date of the accident, where it occurred, who was injured, what the injuries where, and how the accident occurred.

27. If your workers hold a Commercial Driver's License (CDL) or fall under other D.O.T. regulations requiring drug and alcohol testing programs, **please attach a copy of your drug testing policy and a summary of the past three year's results.**

28. From the three options below, provide details regarding your organization's Written Safety Program:

    1. Written Safety Program is currently on file with City Utilities (provide most recent revision date)
    2. Written Safety Program is included with response to this RFP
    3. No Written Safety Program

29. Listing of equipment:

    a. Type and size of equipment to be used for work under this Contract.
    b. Listing of which equipment is owned, rented, and leased.

30. Arbitration/Litigation. List of all projects undertaken in the last 5 years which have resulted in partial or final settlement of the Contract by arbitration or litigation. Provide for each project:

    a. Name of client and project.
    b. Original Contract amount.
    c. Total claims arbitrated or litigated.
    d. Amount of settlement of claims.

******* RFP SPECIFIC QUESTIONS / SUBMITTALS *******

31. Proposer to submit a preliminary section view drawing of the tank proposed for this project. The drawing shall include sufficient detail to illustrate tank geometry, materials of construction, primary dimensions, support wall thickness and pour height, concrete slab thickness, the elevation of low and high water levels, interior wet, interior dry and exterior paint areas, and other information required to show compliance with the specification. If the proposed design does not comply with the specifications, the proposal may be rejected.

EXCEPTIONS

The undersigned declares that the following list states any and all variations from and exceptions to the requirements of the Request for Quotation and that otherwise it is the intent that the work will be performed strictly in accordance therewith. If no exceptions are taken, state "NONE". (Note: use separate page, if necessary)

_____

_____

_____

SUBCONTRACTORS

Each bidder must submit with its proposal the names of all Subcontractors and major suppliers of material and equipment that it intends to use on the job. The Board reserves the right to object to any Subcontractor or supplier.

List items to be subcontracted with proposed subcontractor

PHASE OF WORK	SUBCONTRACTOR
_____	_____
_____	_____
_____	_____
_____	_____

_____ _____

_____ _____

ADDENDA

The undersigned declares that the following listed addenda have been received and all changes required by them are included in the bid amount. If no Addenda have been received, state "NONE". (Note: use separate page, if necessary). Bidders are advised that addenda containing additional information and instruction pertaining to this RFP may be issued at any time. It is the bidder's responsibility to verify, prior to the stated proposal opening date/time, as to whether addenda have been issued.

_____

_____

_____

AUTHORIZED SIGNATURE

The undersigned declares that all interested principals are named herein. No other person or firm has any interest in the proposal or agreement to be entered into; that this proposal is made without collusion with any other person, company, or party, submitting a proposal.

The undersigned understands and agrees that the accompanying bid deposit (if applicable) shall become the property of City Utilities should his proposal be accepted and he fail or refuse to execute the agreement and furnish a performance bond, insurance policies, and certificates of insurance as called for within the time provided.

The Bidder recognizes that City Utilities reserves the right to accept or reject any or all proposals and to waive any technicality or informality therein.

In making this proposal the undersigned has taken into account each provision of all of said Contract Documents and hereby offers this Proposal and agrees to be bound and perform the work according to the terms of the Contract Documents should City Utilities issue a Notice of Award and enter into an Agreement with Bidder.

Firm Name: _____

Name: _____ Title: _____

Signature: _____ Date: _____

Phone #: _____ Fax #: _____

E-mail: _____

END OF SECTION

SECTION 00420
PERFORMANCE, LABOR, AND MATERIALS BOND (SAMPLE)

KNOW ALL MEN BY THESE PRESENTS: That_____, as principal and _____, as surety, are held and firmly bound to the Board of Public Utilities of the City of Springfield, Missouri, hereinafter referred to as City Utilities, in the sum of _____ and no/100 U.S. DOLLARS ($_____ U.S.) for the payment of which we, and each of us, hereby bind ourselves, our heirs, our executors, administrators, successors and assigns firmly by these presents; the conditions of this bond are such that:

WHEREAS, the above-named principal did on the _____day of _____, 20_____, entered into a contract with City Utilities of Springfield, Missouri for:

RFP# 00000052882
ONE MILLION GALLON
BOOSTER II ELEVATED COMPOSITE WATER STORAGE TANK

NOW, THEREFORE, if the above-named principal shall well and truly:

1. Keep and perform all of the contract on his, its or their part to be kept and performed, and faithfully comply with all laws and regulations applicable thereto and complete the same within the time stipulated therein or within a reasonable time if no time is stipulated; and,

2. Pay for any and all materials, incorporated, consumed or used in connection with the construction of the work afore described, and all insurance premiums both for compensation and for all other kinds of insurance on said work above described, and for all labor performed in the work whether by the principal or by subcontractor or otherwise and at the prevailing hourly rate of wages made applicable to the work as specified by the contract (if prevailing hourly rate wages shall have been so specified). This bond is issued under the terms of Section 107.170 R.S.Mo.

Then this obligation shall be void, otherwise it shall remain in full force and effect.

It is understood and agreed that this bond shall not be avoided because of changes in the plans or specifications for the work, or because of extensions of time for the performance of work, and the surety above-named hereby waives notice of and consents to any such changes or extensions of time.

The parties hereto agree that should any litigation arise out of this bond, the venue thereof shall be in the Circuit Court of Greene County, Missouri, or the US District Court for the Western District of Missouri, Southern Division.

IN WITNESS WHEREOF, we have hereto set our hands and seals this _____ day of _____, 20_____, or have caused these presents to be executed by our authorized agent on the same day and year.

Principal: _____

_____

_____

_____

Surety: _____

_____

_____

END OF SECTION

SECTION 00425
AGREEMENT (SAMPLE)

THIS AGREEMENT made and entered into this _____ day of _____by and between the BOARD OF PUBLIC UTILITIES OF THE CITY OF SPRINGFIELD, MISSOURI, hereinafter referred to as "Owner" and

A. [To be used if Contractor is a corporation] _____ a corporation organized and existing under the laws of the State of _____ with its principal office and place of business in the City of _____

B. [To be used if Contractor is a partnership] _____ a partnership consisting of _____ and _____ of the City of _____

C. [To be used by an individual or sole trader] _____ doing business as _____ of the City of _____

hereinafter referred to as the "CONTRACTOR."

WITNESSETH:

THAT, WHEREAS, Owner has heretofore caused to be prepared certain Contract Documents for furnishing equipment, materials, and labor, and performing work therein fully described, and the Contractor did, on the _____ day of _____, _____, file with Owner his offer and bid to perform the work described in the Contract Documents on the terms set forth in his offer, and,

WHEREAS, owner duly accepted the proposal and awarded a contract therefore to contractor, based upon said bid,

NOW, THEREFORE, IT IS AGREED,

1. The Contract Documents (as defined in the General Conditions) are attached hereto and made a part hereof by reference, and those, together with this agreement, comprise the entire agreement between the parties.

2. The Contractor agrees, in the manner set forth in the Contract Documents, to furnish all labor, equipment, and materials necessary to perform the work therein described at the price established in the Bid Form of the Contract Documents.

IN WITNESS WHEREOF, the parties have signed this Agreement on the day and year first above written.

BOARD OF PUBLIC UTILITIES OF THE CITY OF SPRINGFIELD, MISSOURI

By:

_____
Scott Miller
General Manager

Attest:

_____

Approved as to Form and Content:

_____ _____
City Utilities Legal Department Date

CONTRACTOR:

_____
Company Name

_____
By: Authorized Representative's Signature

_____
Print Name

_____
Title

ATTEST:

_____
Signature

_____
Print Name

_____
Title

----- END OF DOCUMENT -----

SECTION 00620
INSURANCE REQUIREMENTS

Without limiting any of the other obligations or liabilities of the Consultant, the Consultant shall secure and maintain at its own cost and expense, throughout the duration of this Contract and until the Work is completed and accepted by City Utilities, insurance of such types and in such amounts as may be necessary to protect it and the interests of City Utilities against all hazards or risks of loss as hereunder specified or which may arise out of the performance of the Contract Documents. The form and limits of such insurance, together with the underwriter thereof in each case, are subject to approval by City Utilities. Regardless of such approval, it shall be the responsibility of the Consultant to maintain adequate insurance coverage at all times during the term of the Contract. Failure of the Consultant to maintain coverage shall not relieve him of any contractual responsibility or obligation or liability under the Contract Documents.

The certificate of insurance, including evidence of the required endorsements hereunder or the policies shall be filed with City Utilities within ten (10) days after the date of the receipt of Notice of Award of the Contract to the Consultant and prior to the start of work. All insurance policies shall provide thirty (30) days written notice to be given by the insurance company in question prior to material reduction in coverage or protection of City Utilities or cancellation of such insurance. Such notices shall be mailed, certified mail, return receipt requested, to:

Risk Manager
City Utilities of Springfield, Missouri
301 E. Central Street
P.O. Box 551
Springfield, MO 65801-0551

The minimum coverage for the insurance referred to herein shall be in accordance with the requirements established below:

(A) Workers' Compensation* ** ..... Statutory
Employer's Liability
Bodily Injury by Accident—each accident…… …… $1,000,000
Bodily Injury by Disease—each employee limit…… $1,000,000
Bodily Injury by Disease—policy limit……..…… $1,000,000

*** Workers' Compensation: Policy or self-insurance plan with statutory limits formally approved by the State of Missouri will be required, even if no employees other than owners.**
**** Workers' Compensation coverage shall include a waiver of subrogation in favor of City Utilities where permitted by law.**

(B) Commercial General Liability Insurance***, Including Premises,
Operations, Products and Completed Operations, Contractual Liability,
Broad Form Property Damage, Independent Consultants,
Such Coverage
Shall Apply to Bodily Injury and Property Damage on an
"Occurrence Form Basis" with each Occurrence Limit of……..……. $1,000,000
In the Aggregate……..… $2,000,000

(C) Umbrella or Excess Insurance*** (Following Form)....…… …….$5,000,000

(D) Automobile Liability Insurance*** Covering Bodily Injury
And Property Damage for Owned, Non-owned and Hired
Vehicles with a Combined Single Limit of……$1,000,000

***** City Utilities shall be added as an Additional Insured on the Liability Insurance coverages.**

(E) Professional Liability Insurance Endorsed for Contractual Liability
Providing Coverage for Acts, Errors, or Omissions Committed
By Consultant with a Combined Single Limit of……..…$1,000,000

(F) All Risk Builders Risk Insurance……Completed Value Basis

The Contractor shall assume all responsibility and save City Utilities from any loss or damage to all materials, equipment and machinery involved under this contract until such time as the project has been completed, tested, and contractually accepted by City Utilities.

Such property insurance shall cover all new construction installation work, testing, and the completed project, with the Named Insureds being the City of Springfield, Missouri, a Municipal Corporation; the Board of Public Utilities of the City of Springfield, Missouri; City Utilities of Springfield, Missouri; Contractor and all subcontractors of any tier including suppliers and vendors, as their interests may appear.

Consultant shall require any and all subcontractors with whom he enters into a contract to perform Work on this Project, to protect, through insurance, against applicable hazards or risks and shall, upon request of City Utilities, provide evidence of such insurance.

Consultant shall be liable for all deductible amounts from such insurance and shall indemnify and hold City Utilities harmless there from.

These Insurance Requirements are intended to be minimum coverages, and City Utilities does not warrant that coverages or amounts will be sufficient protection for contractors or City Utilities. Consultants will be responsible for any deficiencies thereof.

NOTE:

Acord certificate changes regarding cancellation notifications do not lessen the responsibility of vendors to comply with obligations set forth in these insurance requirements. Specifically, the requirement "All insurance policies shall provide thirty (30) days written notice to be given by the insurance company in question prior to material reduction in coverage or protection of City Utilities or cancellation of such insurance." must be met wherever permitted by law.

Since the requirement cannot be met using the Acord certificate, the requirement can be met by (1) specifically endorsing CU onto each policy to receive notifications or (2) any other means that complies with CU requirements.

END OF SECTION

SECTION 00800
SPECIAL CONDITIONS

NONE

The remainder of this page is intentionally blank.

SECTION 01100
SUMMARY OF WORK

PART I. GENERAL

1.01 Location: The Work to be performed under these Contract Documents is located on the north side of Farm Road 116 West of Mulroy Rd (Farm Rd 199) and East of Farm Rd 197.

1.02 General Site Description: A site tour will follow the pre-bid.

1.03 General Description of Work: The Work to be performed under these Contract Documents is generally described as follows:

The design, construction, testing and commissioning of a One Million Gallon Composite Elevated Tank and related work including foundation, painting, electrical, additional control room, hydrodynamic mixing system and appurtenances as shown on the drawings and in accordance with these specifications.

The site will also have a structure adjacent to the tank to feed chlorine gas as a re-chlorination point in the distribution system. Owner will provide a fiber glass building and vault to be placed and set by the Contractor. Contractor will perform work as indicated in the specifications and drawings. City Utilities personnel will connect the chorine system and provide materials as noted on the drawings.

1.04 Scheduling: Complete the Work to be performed under these Contract Documents within four hundred (400) calendar days from issuance of the Purchase Order, which is the Contractor's Notice To Proceed. Project completion includes satisfactory site restoration as determined by the Resident Engineer.

PART II. MATERIALS AND EQUIPMENT

2.01 Consider all work materials, labor, tools, equipment, and incidentals necessary to complete the work contained in the project as completely covered by the lump sum price bid.

2.02 Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

PART III. EXECUTION

3.01 Work by Owner: City Utilities will perform certain activities in connection with the Work with its own personnel as follows:

a. Operate all existing valves and equipment as necessary to isolate the site from the distribution system.

b. Operate all valves and equipment as necessary to fill the tank for disinfection (Contractor is responsible for disinfection of the tank).

c. Installation of Chlorine system as shown on the drawings. City Utilities will provide chlorine cylinders and booster pump. **Contractor is responsible for**

providing and installing of all motive water lines, eductor lines, and appurtenances as shown on the drawings.

3.02 Operation of Existing Facilities: Contractor must coordinate Work activities to avoid conflicts with existing operations, as necessary.

3.03 Material Storage: Store fabricated products above ground, on blocks or skids, to prevent soiling or staining. Store loose granular materials in a well-drained area on solid surfaces. Arrange storage in a manner to provide easy access for inspection or inventory by either the Contractor or the Resident Engineer.

3.04 Contractor Staging Area: Do not store any material, equipment, buildings, tools, vehicles, or any other items owned by the Contractor on property owned by City Utilities except as the specific sites designated for storage and use by the Contractor as approved by the Resident Engineer.

3.05 Unfavorable Construction Conditions: During unfavorable weather, wet ground, or other unsuitable construction conditions, Contractor shall confine its operations to work which will not be affected adversely by such conditions. Construct no work under conditions which would affect adversely the quality or efficiency thereof, unless special means or precautions are taken by Contractor to perform the Work in a proper and satisfactory manner.

3.06 Cleaning Up: Keep the premises free at all times from accumulations of waste materials and rubbish. Provide adequate trash receptacles about the Site and promptly empty the containers when filled.

3.07 Site Administration: Be responsible for all areas of the Site used by it, and by all Subcontractors in the performance of the Work. Exert full control over the actions of all employees and facilities, except such controls as may be specifically reserved to City Utilities or others.

END OF SECTION

SECTION 01140
COORDINATION AND PERMITTING

PART I. GENERAL

1.01 Section includes: Requirements for sequencing and scheduling the Work, overall coordination of Work, customer notification, permits, coordination with others, and coordination between construction operations and plant operations.

A. City Utilities shall obtain all required building permits.

B. Contractor shall obtain permits required for Contractors activities.

C. Contractor shall obtain all necessary permits required by all applicable federal, state, and local codes of construction

D. Contractor shall pay for any bond or other charges associated with obtaining the necessary permits as required in General Conditions, paragraph 6.13. This paragraph shall not be construed as limiting the requirements contained in paragraphs 6.13 and 6.14 of the General Conditions.

E. Contractor shall comply with the conditions of all permits related to the project whether obtained by Owner or Contractor.

1.02 COORDINATION

A. Coordinate the work of all trades under this contract.

B. Coordinate with existing operations to access and use construction area during normal working hours.

C. Coordinate with other contractor activities at the site.

D. Coordinate all activities through the Resident Engineer.

1.03 WORK BY OTHERS:

A. City Utilities reserves the right to perform such work and to contract for such work outside the scope of this Contract as required to complete the Project.

B. The Contractor, by agreeing to perform work under these Contract Specifications, hereby certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work.

C. Other Contracts may be awarded during this Contract time. Some of these Contracts may involve on-site activity which must be coordinated with this Contract. In addition, City Utilities crews may perform other work involving on-site construction, which require coordination with the Project.

1.04 NOTIFICATION AND CUSTOMER RELATIONS

A. Notify all residents affected by work done under this Contract at least 48 hours, but no more than 7 days, prior to starting work in the affected area. Notification shall be of a form and format approved by the Inspector. Execute the work in a customer/neighborhood friendly manner. In addition, notify adjacent utility customers and property owners of proposed location of work equipment parked overnight and of proposed material storage areas and stockpiles of sand, gravel and dirt. Adjust parking and material storage to maximize customer satisfaction and to minimize traffic congestion.

1.05 STORMWATER MANAGEMENT

The owner is estimating that the total area of disturbed land will be less than an acre. Please note that all land disturbers are required to comply with the city code chapter 96 storm water regardless of the size of the land disturbance. In the event that the contractor will be disturbing more than an acre, the following shall pursue.

A. Provide a complete Storm Water Pollution Prevention Plan (SWPPP) for OWNER's use in obtaining land disturbance permits from the City of Springfield and MDNR. CONTRACTOR is responsible for any and all SWPPP modifications required by OWNER and/or City of Springfield. Pay all associated costs of preparing and administering the SWPPP throughout construction and until the site is stabilized.

B. Once SWPPP approval is given by City, CONTRACTOR is responsible for scheduling initial site inspection by City to ensure perimeter control BMPs are installed to the satisfaction of the City. CONTRACTOR must coordinate this with OWNER's representative. The City will issue the land disturbance permit when CONTRACTOR has successfully established perimeter controls. No construction activities may commence until the City land disturbance permit is issued.

C. Install and maintain BMPs as necessary. Modify BMPs as necessary throughout the course of work and modify SWPPP accordingly. Perform and document all inspections required under the SWPPP.

D. CONTRACTOR shall act as OWNER's Authorized Agent thus assuming all responsibility for administering and complying with the SWPPP and permit conditions. The CONTRACTOR will maintain this responsibility until the site is permanently stabilized.

E. CONTRACTOR's SWPPP Officer shall be the CONTRACTOR's Superintendent unless otherwise designated by the CONTRACTOR. This individual, who will be authorized to sign SWPPP inspection reports, must be qualified as defined by the MDNR land disturbance permit. CONTRACTOR shall submit documentation to the OWNER that the designated inspector has a thorough knowledge of sediment and erosion control practices in general and understands the site specific SWPPP requirements. OWNER will not delegate SWPPP authority to the CONTRACTOR until this documentation is provided.

F. Act as responsible party on OWNER's behalf and pay for any penalties associated with violations or non-compliance of Land Disturbance Permit.

G. On completion of the project, the CONTRACTOR shall provide to the OWNER all the original records required by the SWPPP.

H. City of Springfield BMPs Narratives and Details can be found at the following URL:

http://www.springfieldmo.gov/2122/Best-Management-Practices

I. City of Springfield Land Disturbance Permit requirements can be found at the following URL:

http://www.springfieldmo.gov/2124/Land-Disturbance-Permit

1.06 AGENCY COORDINATION

A. Inclusive in the work is close coordination with all appropriate jurisdictional agencies. The Contractor is responsible for determining paving requirements not specifically shown on the drawings (temporary and permanent), construction standards, boring requirements and traffic control and safety requirements of these agencies. No additional payment will be made for compliance to jurisdictional requirements. Contractor is responsible for coordinating the work as described herein.

PART II PRODUCTS – NOT USED

PART III EXECUTION – NOT USED

END OF SECTION

SECTION 01200
MEASUREMENT AND PAYMENT

PART I. GENERAL

1.01 This section further defines the requirements of the General Conditions. Within fifteen (15) days after award of the Contract, prepare and submit to the Resident Engineer an estimated construction progress schedule and Schedule of Values, as further detailed in Section 01330, Submittals.

PART II. MEASUREMENT AND PAYMENT

2.01 Contractor will be paid based on completed items as submitted on Schedule of Values in Section 01330, Submittals.

2.02 Measurement of construction progress will be according to scheduling submitted under Section 01330, Submittals.

2.03 Construct the work for the Lump Sum Price as established by the Bid Form.

2.04 Any delay, additional work, or extra cost to the Contractor caused by or resulting from damage to existing structures, damage to underground installations or work resulting from required deviations from the Contract Drawings shall not constitute a claim for extra work, additional payment or damages.

PART III. EXECUTION

3.01 The Work to be performed under these Contract Documents shall be completed no longer than four hundred (400) calendar days from issuance of the Purchase Order, which is the Contractor's Notice to Proceed. Project completion includes satisfactory site restoration as determined by the Resident Engineer.

3.02 On a monthly schedule, submit requests for partial payment based on work completed and material on hand. Submit the requests for payment to the Resident Engineer on the form provided at the end of this section. The request for payment forms are not part of the Bid Documents.

3.03 Contractor shall deliver and unload all Contractor provided materials F.O.B. job site. Contractor shall unload all City Utilities provided materials delivered to the job site. Contractor shall pickup City Utilities provided materials which are stored at the City Utilities Gas & Water Storeroom, deliver and unload the materials at the job site.

3.04 With final payment request, submit affidavit certifying compliance with wage rate determination.

3.05 Payments will be made no more frequently than once per month as invoiced by the Contractor, based on the work completed on the approved Schedule of Values. Percentages of partial items will not be considered. No extra payment will be made for any item unless a written change order is processed and approved by all parties before the work is started. Only completed measurable units will be paid for.

3.06 Payment for mobilization is limited by the General Conditions to 4% of the original Contract Price unless costs are otherwise documented.

END OF SECTION

SECTION 01200
REQUEST FOR PAYMENT FORM

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END OF SECTION

City Utilities
Connecting Our Community

ESTIMATE FOR PAYMENT

PROJECT: **Booster II Elevated Water Tank**

PAYMENT ESTIMATE NO.:
CONTRACTOR:

Construction Period Ending:

Activity Number:		Project Number:	**WDSC03**
Sub-Category:	**812**	Bidding Event	**52882**
Contract Date:		Operating Unit:	**WTR041**
P.O. Number:	**42683**	Department:	**067**

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by owner	$0.00	$0.00
Total approved this month		$0.00
Totals		$0.00
NET CHANGES by Change Order	Including CO Nos.#	

Contractor hereby certifies that the quantities stated in this estimate for payment are correct; that the work was actually performed; that Contractor is due the payment requested hereunder in accordance with the terms of the contract; and that Contractor has been paid in full for all previous estimates. The Contractor waives all other claims for payment and/or damages arising on or before the date in Section 8, whether arising in contract or tort.

CONTRACTOR

By: _____ Date: _____

I CERTIFY that I have checked the quantities checked by this bill or estimate; that the work was actually performed; that the quantities are correct and consistent with all previous computations as actually checked; that the quantities and amounts are wholly consistent with the requirements of the contract or other instruments involved.

CITY UTILITIES OF SPRINGFIELD

Submitted By: _____ Date: _____

Resident Engineer James Okumu, P.E.

Approved By: _____ Date: _____

Department Director Robert Wilson

Construction Value Completed Total to Date: _____

Stored Materials not Incorporated in Work: **$0.00**

1	**ORIGINAL CONTRACT SUM**	
2	**NET CHANGE BY CHANGE ORDERS**	$0.00
3	**CONTRACT SUM TO DATE** (Line 1 + Line 2)	$0.00
4	**TOTAL COMPLETED & STORED TO DATE**	$0.00
5	**RETAINAGE**	
	a. 10 % of Completed Work (Columns D + E from attached form)	$0.00
	b. 10 % of Stored Material (Column F from attached form)	$0.00
	Total Retainage (Line 5a + 5b) Total in Column I (from attached form)	$0.00
6	**TOTAL EARNED LESS RETAINAGE** (Line 4 - Line 5)	$0.00
7	**LESS PREVIOUS CERTIFICATES FOR PAYMENT**	
8	**CURRENT PAYMENT DUE** (Line 6 - Line 7)	$0.00
9	**BALANCE TO FINISH, INCLUDING RETAINAGE** (Line 3 - Line 6)	$0.00

SECTION 01310
PROJECT PROGRESS MEETINGS

PART I. GENERAL

1.01 Progress meetings shall be held during the course of the work on at least a monthly basis. Additional meetings may be scheduled as required.

1.02 The Resident Engineer shall schedule the time and location of the meetings and alert interested parties.

1.03 Contractor, Contractor's site foreman or other knowledgeable contractor personnel shall attend the meetings.

1.04 A pre-construction meeting shall be scheduled prior to start of construction on the project to discuss any aspect of the prosecution of the work.

1.05 Contractor, Resident Engineer, and Operations personnel shall meet prior to start of construction to determine sequencing of operations.

1.06 Contractor shall attend coordination meetings with City Utilities' Resident Engineer, and other contractors working on site. Meetings shall be conducted by the Resident Engineer.

1.07 Contractor shall provide a bar chart type schedule showing the work to be done and the number of days planned for each activity to the pre-construction meeting.

PART II. MATERIALS – *Not Used.*

PART III. EXECUTION – *Not Used.*

END OF SECTION

SECTION 01330
SUBMITTALS

PART I. GENERAL

1.01 Provide submittals as specified herein and in each section of the Contract Specifications.

PART II. SHOP DRAWINGS AND ENGINEERING DATA

2.01 Submit information and drawings on all materials, equipment, hardware, and finishes as required herein and in each section of the Contract Specification. Provide submittals at least two weeks prior to obtaining the materials so that the Resident Engineer may approve the materials.

2.02 Submit shop drawings to the Resident Engineer for review, not as a check of details but for the purpose of determining whether or not the general method of fabrication, quality of materials and equipment and detailing are in accordance with the Contract Specifications and are suitable for instruction of operating personnel and for maintenance.

2.03 Unsuitable materials already on-site may be subject to rejection by the Resident Engineer if proper submittals were not filed ahead of time. Materials already incorporated in work will be removed and replaced if they do not conform to the Specifications and were not officially approved by the Resident Engineer.

2.04 Shop Drawings shall detail equipment outlines and dimensions, foundation requirements, piping and wiring diagrams, and shall give complete information for installation, erection, maintenance and repair, and for identification of parts for ordering replacements on each item to be furnished under the Contract. Such Shop Drawings shall conform to the following requirements:

1. Submit five (5) sets of all drawings to the Resident Engineer for approval before construction work is commenced in the factory. At the time of submission, the Contractor shall call City Utilities' attention to any deviations that the Shop Drawing may have from the requirements of the Contract Documents in writing. One copy of each drawing will be returned to the Contractor. City Utilities will return drawings within two weeks (2) after receipt of same with one of the following remarks:

   a. "Reviewed" indicates Shop Drawings have been reviewed and appears to be in general conformance with the Specifications. The Contractor shall make further distribution of the Shop Drawing and may proceed with fabrication shown on the Shop Drawing incorporating the comments noted thereon, if any.

   b. "Resubmit" indicates Shop Drawings or part thereof does not appear to be in general conformance with the Specifications. The Resident Engineer's comments will be noted on the Shop Drawing or in a separate letter.

   Recheck, make necessary revisions and resubmit for the Resident Engineer's review.

c. "Reference" indicates Shop Drawing gives information that is incidental to the Specifications and is for general information only.

2. City Utilities' approval of Shop Drawings does not relieve the Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless the Contractor has in writing called City Utilities' attention to such deviation at the time of submission and City Utilities has given written approval to the specific deviation, nor does any approval by City Utilities relieve Contractor from responsibility for errors or omissions in the Shop Drawings. Contractor's stamp of approval on any Shop Drawing constitutes a representation to City Utilities that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials catalog numbers, and similar data, or he assumes full responsibility for doing so, and that he has reviewed or coordinated each Shop Drawing with the requirements of the Work and the Contract Documents.

3. Approval Drawings - Include drawings specified above. Drawings shall be legible and shall include all spare parts and auxiliary equipment to be furnished. Provide shop drawings no smaller than 8 1/2 inches by 11 inches and not larger than 30 inches by 42 inches. All drawings shall comply with ANSI Y14, latest published revision. Include the following minimum information on each drawing and certified document:

   a. Contract Number - Inquiry No.
   b. Manufacturer's Name
   c. Manufacturer's Shop Order Number
   d. Manufacturer's Drawing Number
   e. Manufacturer's Serial Number, when applicable
   f. Owner's Job Order No.
   g. Project Location

4. No design drawings, data, etc., will be considered for review which are not complete in all respects and which have not been thoroughly checked by the Contractor. No design drawings, data, etc., will be considered for review that are contingent upon other features which have not been submitted for review.

   The Resident Engineer will review the drawings, data, etc., for compliance with specifications, will mark them to indicate whether changes or corrections are required and will return one set to Manufacturer. The Manufacturer shall re-submit the corrected or changed drawings, data, etc. Clearly indicate changes, corrections, etc.

5. City Utilities acceptance does not relieve the Manufacturer from any liability or responsibility for proper design, fabrication or compliance with this specification.

6. Include design information on the drawings. The fact that such design information may later be included in the instruction and/or operating manuals does not relieve the Manufacturer from compliance with this requirement.

7. Where standard drawings are furnished which cover a number of variations of the general class of equipment, individually endorse each such drawing on the back to describe exactly which parts of the drawing apply to the equipment being

furnished. Also include the job name, contract number and serial number of the particular item covered in the endorsement. Separate sheets of paper bearing this endorsement will not be acceptable unless pasted or stenciled individually on the rear of each print submitted.

8. Final Prints and Instruction Books - Include all drawings specified above. Provide legible drawings referenced as to project, order number, etc. Index and bind final drawings, instruction books, parts data, etc. into a common binder. Reference the project on the cover sheet. Include manufacturer's catalog cuts or booklets for all miscellaneous materials in the instruction book.

9. Quality - Provide legibility of drawings and data submitted of such quality that said drawings and data are capable of yielding hard copy reproductions with every line, character and letter clearly legible.

10. Documents submitted to the Resident Engineer that do not conform to the requirements of this specification will be subject to rejection by City Utilities. Manufacturer shall re-submit conforming documents. If conforming submittals cannot be obtained from the source documents, retrace, redraw or photographically restore as may be necessary to meet such requirements. Manufacturer's (or his subcontractor's) failure to initially satisfy the legibility quality requirements, herein set forth, will not relieve Manufacturer (or his subcontractor) from meeting the required schedule for submittal of drawings and data.

11. Mailing of Drawings and Data - Mail all documents flat (folded) with chip board protectors on top and bottom of the transmittal. A letter of transmittal must accompany drawings, data, etc. All transmittals received without a letter of transmittal containing such information will be returned to sender. In his letter, Contractor may include other pertinent data or information.

2.05 Instructions for Shop Drawing Transmittal:

1. Attach a copy of the "Shop Drawing Transmittal," Form #SDT to each group of Shop Drawings, manufacturers' literature, and equipment data submitted.

2. Number each transmittal consecutively and insert the number in the space provided. Assign resubmittals a new transmittal number, but indicate the transmittal number used on the original transmittal under the new number.

3. Enter the Specification Section No. in the space provided.

4. Mark the number of copies enclosed under the column "Number of Copies." The Contract Documents indicate the number of required copies.

5. Indicate new submittals, resubmittals, or additional copies of drawings by use of an "X" in the proper column. Do not include new submittals and resubmittals on the same transmittal form. Use a separate column for each category.

6. Also use a separate transmittal form for materials submitted. Show the part number to which the transmittal applies on the transmittal.

7. Complete the information required under the column headings "Manufacturer," "Manufacturer's Number," and "Subject." The brief title under "Subject" should clearly distinguish the equipment or material covered by the drawing from other equipment and material furnished under the Contract.

8. The right-hand side of the transmittal form will be filled out by the Owner, indicating the Owner's reference number, action taken, distribution of copies, and any additional copies which are required. Normal distribution of copies of the Shop Drawings is set forth in the Contract Documents.

PART III. SCHEDULE OF VALUES AND CONSTRUCTION SCHEDULE

3.01 Schedule of Values. Within 15 days after award of the Contract, submit the Schedule of Values for approval. Use the approved Schedule when preparing the Request for Payment forms.

3.02 Construction Schedule. Furnish the owner three (3) copies of a graphic construction schedule for approval fifteen (15) days after award of the Contract. Break the contract down into major phases or items as shown on the graphic construction schedule. Show for each phase and item, when applicable, the following as a minimum (hard copy and digital format including schedule software):

A. Date Work will begin

B. Period of performance

C. Date Work will begin on shop drawings

D. Date drawings will be submitted for approval

E. Date orders will be placed for material

F. Dates of shipment and delivery

G. Periods of installation and erection for all major components

H. Percent of Work that will be completed each month

I. Date of completion

3.03 City Utilities will review the schedule submittal for approval and request changes as required.

3.04 Do not change the approved construction schedule without prior approval from City Utilities.

3.05 Within ten (10) days after Award of Contract to Contractor, a pre-construction conference will be held at City Utilities' Blackman Water Treatment Plant, 2601 S Blackman Rd, Springfield, Missouri, 65809 which shall be attended by the Contractor's Project Manager

and the Contractor's Field Superintendent. This conference will be for the purpose of discussing the details of the equipment and materials to be furnished and the schedule and manner in which the manufacturer's drawings are to be prepared and submitted and the scheduling of the phases of construction.

3.06 Conform to the schedule and keep the Resident Engineer informed of any circumstances that might adversely affect the construction schedule.

3.07 Submit weekly progress reports to the Resident Engineer which explain the progress correlated to the construction schedule.

END OF SECTION

SECTION 01425
REFERENCES

PART I. GENERAL

1.01 References and Abbreviations. The latest edition of the following specifications cover certain materials and methods to be utilized by the Contractor. Abbreviations as used in the Contract Documents mean the following:

1. AWWA: American Water Works Association
2. AGA: American Gas Association
3. AASHTO: American Association of State Highway & Transportation Officials
4. API: American Petroleum Institute
5. ASA: American Standards Association
6. DOT: Federal Department of Transportation
7. AWS: American Welding Society
8. AREA: American Railway Engineering Association
9. ACI: American Concrete Institute
10. OSHA: Occupational Safety and Health Administration
11. ASTM: American Society for Testing and Materials
12. ANSI - American National Standards Institute
13. IEEE - The Institute for Electrical and Electronics Engineers
14. NACE - National Association Corrosion Engineers

1.02 References and Dates. All standards references apply to the most current versions of these standards except where noted.

PART II. MATERIALS – *Not Used.*

PART III. EXECUTION – *Not Used.*

END OF SECTION

SECTION 01450
CONTRACTOR'S QUALITY CONTROL

PART I. GENERAL

1.01 Establish a quality control system to ensure conformance of all items of work, including that of subcontractors, to applicable Contract Specifications and Drawings with respect to the materials, workmanship, construction, finish, functional performance, and identification. Provide the controls adequate to cover all layout and construction operations and keyed to the proposed construction sequence. Establish this control for all construction. City Utilities may perform inspections or tests for quality assurance as deemed necessary by Resident Engineer. Provide an outline of this quality control system and provide periodic report of status.

1.02 The Contractor's field superintendent, to the extent qualified, may be used for quality control, supplemented as necessary by additional personnel for surveillance, special technicians, or testing facilities to provide capability for the controls required by the Contract Specifications.

PART II. MATERIALS – *Not Used.*

PART III. EXECUTION

3.01 Provide for supervision of each phase of work to ensure that materials and supplies are placed and installed in accordance with the Contract Drawings and Specifications. Do not build upon or conceal any feature of work containing uncorrected defects.

3.02 Perform certification testing of materials and workmanship described in the specifications.

END OF SECTION

SECTION 01460
INSPECTIONS

PART I. GENERAL

1.01 All work on the Construction Project shall be subject to inspection, examination or test, at any time and from time to time, by the Resident Engineer.

1.02 The Resident Engineer has the right and authority to determine whether the work is being done in accordance with the requirements of the Contract Documents, Drawings, and Specifications. The decision of the Resident Engineer as to the acceptance of any completed work or materials will be final.

1.03 In the event of Contractor non-compliance with the requirements of these Contract Documents, the Resident Engineer has the right to require the Contractor to stop work until such deficiencies are corrected. Failure to stop work will result in the appropriate penalties to the Contractor described elsewhere in these Documents.

PART II. MATERIALS – *Not Used.*

PART III. EXECUTION – *Not Used.*

END OF SECTION

SECTION 01520
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART I. GENERAL

1.01 The Contractor shall be responsible for supplying all of the facilities needed for the successful completion of the job. Locate equipment and material storage within project limits. Maintain all working, storage, and parking areas in a neat and orderly manner.

1.02 Contractor shall provide a temporary construction office and all required utilities for complete execution of the contract.

1.03 Provide Resident Engineer with telephone numbers at which Contractor or his representatives(s) may be contacted at any time. Give representative full authority of Contractor in absence of the Contractor. Designate a minimum of two people as after-hours contacts.

1.04 Contractor shall provide design of Best Management Practices (BMP's) as required and obtain from the City of Springfield a Land Disturbance Permit including CONTRACTOR design Storm Water Pollution Prevention Plan (SWPPP).

1.05 RELATED SECTIONS

A. Sections 11.5.5.2 and 14.2.1 of the General Conditions

PART II. MATERIALS AND EQUIPMENT – *Not Used.*

PART III. EXECUTION

3.01 Furnish storage space, sanitary facilities, trash disposal, and utilities. Materials may be stored. No telephone, potable water, or sanitary facilities are available for the Contractor's use.

3.02 Park workmen's vehicles in an area designated by the contractor to prevent interference with normal facility operations.

3.03 Upon completion of the project, remove all traces of temporary facilities. Fill all disturbed grass areas, grade and seed. Replace all paving and concrete to original condition.

3.04 Maintain the continuity of security systems. Gates shall be closed when workers are not present. Provide gate locks to interlock CU's locks if applicable.

3.05 Provide and install a tire wash area as shown on the drawings. Use as required to prevent tracking of material to the public rights of way.

3.06 TEMPORARY UTILITIES

A. General: Cost or use charges for temporary utility facilities are not chargeable to the OWNER and shall be included in the Contract Sum unless otherwise noted.

B. Water Service:

1. Use water from the OWNER's existing water system.

2. CONTRACTOR shall pay for all required materials and installation costs of temporary water service; including meter assembly for OWNER's tracking purposes. Water usage will be recorded for OWNER's purposes but will not be charged to CONTRACTOR.

3. A hydrant near the construction site may be used for water service if outdoor temperatures are above freezing or the CONTRACTOR protects the hydrant and service lines from freezing. A hydrant meter would be required.

C. Electric Power Service:

1. CONTRACTOR may elect to install temporary electric service from the utility's existing distribution lines. CONTRACTOR shall pay for all costs for removal, installation, and usage rates for the duration of usage.

2. Contact Developer Services at 417.831.8888 to establish electric service.

3. Installation and removal costs will depend on field office site to be determined by CONTRACTOR.

D. Sanitary Facilities:

1. Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.

2. Provide containers or holding tanks to remove and dispose of effluent off-site in a sanitary and lawful manner.

3.07 MATERIAL DELIVERY, HANDLING, AND STORAGE

A. For OWNER furnished materials:

1. The Inspector will order materials from City Utilities storeroom for contractor as needed for the project. Requests for materials should be submitted to the Inspector at least 24 hours in advance.

2. Contractor shall pick up requisitioned materials at the City Utilities stores facility designated by the Inspector. Provide adequate transportation and labor to load and receive materials, except that City Utilities will provide a forklift and operator as necessary to load heavier items. Provide wood

blocking, straps, tarps, etc. required for hauling the materials. Materials may be picked up from 9:00 a.m. to 3:00 p.m. Monday through Friday, except holidays.

3. Consider all labor, tools, equipment and incidentals necessary to complete the work, as well as any materials not specifically provided by City Utilities, to be completely covered by the prices bid.

4. Contractor shall be responsible for the material, and for the replacement of lost, broken or stolen material. Contractor shall examine all material upon receipt, and by acceptance, certify suitability for use. Make objections to issued materials to the Inspector.

5. Pick up items normally packaged in bulk quantities in such bulk quantities. Unused quantities will be returned to the stores facility by the Contractor or transferred to the next job as long as additional work continues. The Inspector will make appropriate requisitions, transfers and returns for each project.

6. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

B. Store fabricated products above ground, on blocking or skids, to prevent soiling or staining. Store loose granular materials in a well-drained area on solid surfaces. Arrange storage in a manner to provide easy access for inspection or inventory by either the Contractor or the Inspector.

C. Do not damage public or private property in handling or storage of materials. Do not hinder access to fire hydrants, fire and police alarms, mailboxes, water valves, gas valves and manholes.

D. Do not use private property for storage of materials without express written permission of property owner. Provide Inspector with documentation of permission to store materials.

E. Do not store any material, equipment, buildings, tools, vehicles or any other items owned by the Contractor on property owned by City Utilities except at the specific sites designated by the Inspector or as shown on the drawings for storage and use by the Contractor. If no sites are designated, then the Contractor is responsible for locating and procuring any required site or sites.

F. Make periodic inspection of stored products to ensure that products are maintained under specific conditions, and free from damage or deterioration.

3.08 ENVIRONMENTAL PROTECTION

A. Conduct all construction activities in conformance with all federal, state and local laws, regulations and ordinances for the protection of the environment.

B. The work under this Contract may affect the City of Springfield’s drinking water supply. Under no circumstances shall the Contractor or any of his subcontractors

allow any debris, fuel, chemicals, liquids or other materials to enter this water supply through direct or indirect means. Contain and dispose of all materials by means acceptable to the appropriate jurisdictional agency. Have materials on-site for containment of spills such as hydraulic hose breaks, etc.

END OF SECTION

SECTION 01720
FIELD ENGINEERING

PART I. GENERAL

1.01 This Section includes requirements for surveying and job layout.

1.02 Related Sections

A. Sections 4.4, 6.3 and 11.5.4 of the General Conditions

1.03 QUALITY ASSURANCE

A. Qualifications of surveyor or ENGINEER: Registered civil engineer or land surveyor in the state of MISSOURI.

PART II. MATERIALS – *Not Used.*

PART III. EXECUTION

3.01 Contractor shall furnish all vertical and horizontal surveying controls as necessary for the execution of the work as shown on the Drawings.

3.02 The Contractor is solely responsible for locating all existing underground facilities before excavating or trenching, by contacting the owners thereof, prospecting, and the use of the Missouri One-Call System and other appropriate locating services. Although some underground facilities might be shown on the Drawings, the Drawings do not represent the location or depth of underground facilities or even the existence of all underground facilities. The Contractor shall use its own information and shall not use the Drawings to locate underground facilities. Contractor shall use all reasonable means necessary to avoid damage to underground facilities including, without limitation, hand-digging.

END OF SECTION

SECTION 01770
CONTRACT CLOSE-OUT/CLEANUP

PART I. GENERAL

1.01 Upon substantial completion of the Contract Work, the site will be inspected by the Resident Engineer and a final punchlist compiled. This punchlist will itemize specific work items to be completed before final payment.

1.02 Follow instructions in Section 01200 for submittal of final payment forms.

PART II. MATERIALS – *Not Used.*

PART III. EXECUTION

3.01 Completely remove all traces of equipment, excess materials, and debris from the site after all punchlist items have been completed, inspected, and approved by Resident Engineer.

3.02 Clean-up site to Resident Engineer's satisfaction and to leave a tidy, completely functional site as set forth in these Documents.

END OF SECTION

SECTION 02200
EARTHWORK

PART I GENERAL

1.01 This section covers earthwork and shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation; handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of sub-grades; pumping and dewatering as necessary; protection of adjacent property; backfilling; construction of fills and embankments; surfacing and grading; and other appurtenant work.

1.02 Related Work Described Elsewhere:

A. Section 02900 – Landscaping
B. Section 13210 – Composite Elevated Water Storage Tank
C. Appendix A - Geotechnical Engineering Report by Palmerton & Parrish, Inc.

1.03 Regulatory Compliance: All excavation and backfill is subject to regulations and permits of appropriate jurisdictional agencies. Include compliance to said regulations and permitting requirements in the scope of the Work.

1.04 Submittals: Complete descriptive and engineering data for all materials incorporated into the Work shall be submitted in accordance with the submittals section.

PART II MATERIALS AND TESTING

2.01 Geotextile Fabric (if used): Filter fabric shall be provided in rolls wrapped with covering for protection from mud, dirt, dust, and debris. Filter fabric shall be a nonwoven fabric consisting of only continuous chains of polymeric filaments or yarns of polyester formed into a stable network by needle punching. The fabric shall be inert to commonly encountered chemicals; shall be resistant to mildew, rot, ultraviolet light, insects, and rodents. The fabric mass per unit area shall be 5.7 ounces per square yard minimum and the minimum apparent opening size shall be 70, U.S. Standard Sieve Size.

2.02 Geocomposite Sheet Drain: The geocomposite sheet drain shall consist of a continuous plastic three-dimensional drainage core wrapped on one side in a nonwoven filter fabric permeable to water flow. The filter fabric shall be bonded to the individual dimples of the molded plastic core to minimize fabric intrusion into the flow channels caused by backfill pressure. The fabric shall extend beyond the edges of the core to provide overlap for the adjacent panels.

2.03 Riprap: Riprap for use as an apron for the concrete splash pad shall comply with MODOT Type 3 Rock Ditch Liner and consist of material with a predominant rock size of 12 inches, a maximum rock size of 20 inches and a gradation such that no more than 15 percent will be less than 4 inches.

2.04 General Fill and Embankment Materials. To the maximum extent available, excess suitable material obtained from structure and trench excavation shall be used for the

construction of general fills and embankments. Borrow pits may be opened on site, at locations as approved by the Resident Engineer, depending on results of material testing. Borrow areas if required shall be selected at least two weeks prior to starting excavation in order to provide time for material testing, by the soils laboratory.

General fill and embankment materials shall consist of inorganic low plasticity lean clay with or without chert fragments.

All material placed in fills and embankments shall be free from rocks or stones larger than the required size in their greatest dimension, brush, stumps, logs, roots, debris, and other organic or deleterious materials. The maximum size of stone in fills and embankment shall be 4 inches. No rocks or stones shall be placed in the upper 18 inches of any fill or embankment. Rocks or stones within the allowable size limit may be incorporated in the remainder of fills and embankments, provided they are distributed so that they do not interfere with proper compaction.

2.05 Granular Fill. Granular fill material shall be crushed rock or gravel suitable for use in a free draining foundation drain and as a sub base beneath the concrete splash pad. Granular fill shall be free from dust, clay, and trash; hard, durable, non-friable; and shall be graded 3/4 inch to No. 4 as defined in ASTM C33 for No. 67 coarse aggregate. Granular fill shall meet the quality requirements for ASTM C33 coarse aggregate. Only crushed rock with angular particles shall be used when the perimeter of the granular fill is not confined or otherwise subject to raveling, such as on a slope.

2.06 Structure Backfill. Structure backfill shall be defined as the material placed around and outside of the tank. Structure backfill shall meet the requirements of the previous paragraph entitled "General Fill and Embankment Materials".

2.07 SELECT FILL. Select fill shall be defined as the material placed beneath the tank foundation and slab below any leveling base material indicated on the Drawings. Select fill shall be used to replace any unsuitable material below the tank foundation and slab and to raise the site grades below and within 5 feet of structural footprint and at locations indicated on the Drawings. Select fill shall be as indicated herein.

2.08 General Fill Select Fill. General fill for use as select fill shall meet the requirements of the previous paragraph entitled “General Fill and Embankment Materials”.

2.09 Rock Fill Select Fill. Rock fill for use as select fill shall consist of rock having maximum dimensions in excess of 4 inches, but no greater than 12 inches.

2.10 TESTING

A. Preliminary Review of Materials. As stipulated in Section 01450 – CONTRACTOR’S QUALITY CONTROL, all tests required for preliminary review of materials shall be made by an acceptable independent testing laboratory at the expense of Contractor. Two initial gradation tests shall be made for each type of general fill, designated fill, backfill, or other material, and one additional gradation test shall be made for each additional 500 tons of each material delivered to the jobsite. In addition, one set of initial Atterberg Limits test shall be made for each fill material containing more than 20 percent by weight pass the No. 200 sieve and

for materials specified by Atterberg Limits. One additional Atterberg Limits test shall be made for each additional 500 tons of each material delivered to the job site.

B. Field Testing Expense. All moisture-density (Proctor) tests and relative density tests on the materials, and all in-place field density tests, shall be made by an independent testing laboratory at the expense of Owner. Contractor shall provide access to the materials and work area and shall assist the laboratory as needed in obtaining representative samples.

C. Required Field Tests. For planning purposes the following guidelines shall be used for frequency of field tests. Additional tests shall be performed as necessary for job conditions and number of failed tests. Test results shall be submitted as indicated in Section 01330 – SUBMITTALS.

1. Two moisture-density (Proctor) tests in accordance with ASTM D698 or two relative density tests in accordance with ASTM D4253 and D4254 for each type of general fill, designated fill, backfill, or other material proposed.
2. For area fills and embankments, an in-place field density and moisture test for each 1000 cubic yards of material placed.
3. One in-place field density and moisture test for every 100 to 200 cubic yards of structure backfill or select fill.
4. One in-place density and moisture test whenever there is a suspicion of a change in the quality of moisture control or effectiveness of compaction.
5. At least one test for every full shift of compaction operations on mass earthwork.
6. Additional gradation, proctor, and relative density tests whenever the source or quality of materials changes.

PART III EXECUTION

3.01 Safety: Excavation work shall be performed in a safe and proper manner, with suitable precautions being taken against hazards of any kind. Excavations shall provide adequate working space and clearances for the work to be performed. Spoil banks, excavation storage piles, and topsoil stockpiles shall not interfere with the transportation, storage, handling of materials, or performance of the Work.

3.02 Protections: Protect structures, utilities, pavement, and other facilities at the Project Site.

3.03 Site Preparation. All sites to be occupied by permanent construction or embankments shall be cleared of all logs, trees, roots, brush, tree trimmings, and other objectionable materials and debris. All stumps shall be grubbed. Subgrades for fills and embankments and sites to be occupied by permanent construction shall be cleaned and stripped of all surface vegetation, sod, and organic topsoil. All waste materials shall be removed from the site and disposed of by and at the expense of Contractor.

3.04 EXCAVATION. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. Sub-grade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.

3.05 Classification of Excavated Materials. Separate classification of excavated materials will not be made. Excavation work shall include the removal and subsequent handling of earth and/or other materials excavated or otherwise removed in performance of the Work, regardless of the type, character, composition or condition thereof. It shall also include the removal and disposal of all stone and other materials encountered within the limits of excavation. There shall be no change in the Contract Price due to rock, whether foreseen or unforeseen, regardless of the hardness or type of rock.

3.06 Blasting. Blasting or other use of explosives for excavation will not be permitted.

3.07 Dewatering. Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level to the minimum depth of 12 inches beneath such excavations. The specified dewatering depth shall be maintained below the prevailing bottom of excavation at all times.

Surface water shall be diverted or otherwise prevented from entering excavations or trenches to the greatest extent possible without causing damage to adjacent property.

Contractor shall be responsible for the condition of any pipe or conduit used for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

3.08 Spoils Area: Stockpile and maintain excess excavated materials where directed by the Resident Engineer, until required for backfill and fill. Restore these areas to satisfactory condition before final payment is approved.

3.09 Stabilization. Sub-grades for concrete structures shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workers.

Sub-grades for concrete structures which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel as specified for granular fills. The stabilizing material shall be placed in such a manner that no voids remain in the granular fill. All excess granular fill with unfilled void space shall be removed. The finished elevation of stabilized sub-grades shall not be above sub-grade elevations indicated on the Drawings.

3.06 GENERAL FILLS AND EMBANKMENTS. Fills and embankments not required or indicated to be designated fills shall be constructed as general fills and embankments. All

fills and embankments shall be constructed to the lines and grades indicated on the drawings. Backfill materials shall be deposited in layers not to exceed 8 inches in uncompacted thickness and shall be compacted to at least 90% of maximum density as determined by Standard Proctor Procedures (ASTM D698). The soil moisture shall be as required to achieve specified compaction density.

Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of Resident Engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

3.07 Sub-grade Preparation. After evaluation by proof-rolling and approval of the preparation of the fill or embankment site, the sub-grade shall be scarified and moisture conditioned to a minimum depth of 8 inches, leveled and rolled so that surface materials of the sub-grade is within 2 percent of the optimum moisture content and as compact and well bonded with the first layer of the fill or embankment as specified for subsequent layers.

Unless otherwise directed by Resident Engineer, the sub-grade shall be proof-rolled by a rubber-tired roller, a loaded dump truck, or other suitable rubber-tired equipment acceptable to Resident Engineer. A minimum of four passes of the proof-rolling equipment shall be provided such that the last two passes are made perpendicular to the first two passes.

All soft, yielding, or otherwise unsuitable material shall be removed and replaced with compacted fill.

3.08 Placement and Compaction. All fill and embankment materials shall be placed in approximately horizontal layers not to exceed 8 inches in un-compacted thickness. Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled before compaction.

Each layer of material shall have the best practicable moisture content for satisfactory compaction. The material in each layer shall be wetted or dried to achieve the moisture content relative to optimum as specified above, and shall be thoroughly mixed to ensure uniform moisture content and adequate compaction. Each layer shall be thoroughly compacted to the required degree of compaction at the required moisture content. If the material fails to meet the density specified, compaction methods shall be altered. The changes in compaction methods shall include, but not be limited to, changes in compaction equipment, reduction in uncompacted lift thickness, increase in number of passes, and better moisture control.

Wherever a trench is to pass through a fill or embankment, the fill or embankment material shall be placed and compacted to an elevation not less than 12 inches above the top of pipe elevation before the trench is excavated.

3.09 Borrow Pits. Suitable material necessary to complete fills and embankments may be excavated from borrow pits onsite. Borrow areas if required shall be selected at least two weeks prior to starting excavation in order to provide time for material testing, by the soils laboratory. The size, shape, depth, drainage, and surfacing of all borrow pits shall be acceptable to Resident Engineer. Borrow pits shall be regular in shape, with graded

and surfaced side and bottom slopes, when completed. Side slopes of borrow pits shall be not steeper than 3 horizontal to 1 vertical and shall be uniform for the entire length of any one side.

3.10 DESIGNATED FILLS. Fills required or indicated to be designated fills shall be constructed using the specific materials and placement requirements as specified. In addition to the specific requirements specified herein, all requirements for general fills and embankments shall apply. These requirements include, but are not limited to organic or deleterious materials, subgrade preparation, lift thickness, and moisture conditioning requirements. All designated fills shall be constructed to the lines and grades indicated on the drawings. Backfilling and construction of fills during freezing weather shall not be done except by permission of Engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

3.11 Granular Fill. Granular fills shall be provided based on the Geotechnical Report. Granular fills shall be placed on suitably prepared sub-grades per the Geotechnical Report.. Granular fills shall be compacted as recommended in the Geotechnical Report.

Where granular fills are to be covered with concrete, the top surface shall be graded to the required sub-grade elevation. The completed fill shall be covered by a vapor barrier.

3.12 Structure Backfill. Backfill materials shall be deposited in layers not to exceed 8 inches and shall be compacted per the requirements of the Geotechnical Report. The soil moisture shall be as required to achieve specified compaction density.

Compaction of structure backfill shall be performed in such a manner that damage to the tank is prevented. The compaction equipment used within 8 feet of the walls and for the top 8 feet of backfill shall have no restriction on type. Limit of equipment weight shall be 1 ton. Compaction of structure backfill by inundation with water will not be permitted.

No backfill shall be deposited or compacted in water.

Particular care shall be taken to compact structure backfill which will be beneath pipes, drives, roads, parking areas, walks, curbs, gutters, or other surface construction or structures. In addition, wherever a trench is to pass through structure backfill, the structure backfill shall be placed and compacted to an elevation not less than 12 inches above the top of pipe elevation before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.

3.13 General Fill Select Fill. Select fill shall be placed in nearly horizontal layers in uncompacted lift thickness of 8 inches or less and shall be compacted per the requirements of the Geotechnical Report. The soil moisture shall be as required to achieve specified compaction density.

3.14 Rock Fill Select Fill. Rock material shall be placed in horizontal layers having a thickness of approximately the maximum size of the larger rock comprising the lift, but no greater than 8 inches. Rocks or boulders too large to permit placing in a 8 inch thick lift should be reduced in size as necessary to permit placement or not used in the compacted fill. Rock

fill shall not be dumped into place, but shall be distributed in horizontal lifts by blading and dozing in such a manner as to ensure proper placement into final position in the excavation. Finer material including rock fines and limited soil fines shall be worked into the rock voids during this blading operation. Excessive soil and rock fine particles preventing interlock of cobble and boulder sized rock shall be prohibited. Rock fill shall be compacted by a minimum of 4 passes by a large diameter self-propelled vibratory roller.

If improper placement procedures are observed during the placement of the fill, no additional fill shall be permitted on the affected area until the condition causing the low densities has been corrected and the fill has been reworked to obtain sufficient density.

3.15 FINAL GRADING AND PLACEMENT OF TOPSOIL. After other outside work has been finished, and backfilling and embankments completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours. All cuts, fills, embankments, and other areas which have been disturbed or damaged by construction operations shall be surfaced with topsoil to a depth of 4 inches. Topsoil shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones, and debris, and well suited to support plant growth.

Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to manual methods. All surfaces shall be graded to secure effective drainage. Unless otherwise indicated, a slope of at least 1 percent shall be provided.

Final grades and surfaces shall be smooth, even, and free from clods and stones, weeds, brush, and other debris. Coordinate seeding with fine grading work, so that seeding and fertilizing may proceed immediately after fine grading.

3.16 DISPOSAL OF EXCAVATED MATERIALS. Suitable excavated materials may be used in fills and embankments as needed. Excess material shall be disposed of on-site as directed by the Resident Engineer; all such material shall be graded for drainage but need not be compacted. Covering of rock and seeding will be required.

All debris, stones, logs, stumps, roots, and other unsuitable materials shall be removed from the site and disposed of by, and at the expense of, Contractor.

3.17 SETTLEMENT. Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the General Conditions. Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from Owner.

END OF SECTION

SECTION 02315
EXCAVATION AND BACKFILLING FOR PIPING

PART I GENERAL

1.01 DESCRIPTION: Work includes, but is not limited to:

A. Trenching and trench backfilling.

B. Blasting and rock excavation.

C. Rough and finish grading.

D. Furnishing and installing granular fill.

1.02 REGULATORY COMPLIANCE

All excavation and backfill is subject to regulations and permits of appropriate jurisdictional agencies.

1.03 RELATED SECTIONS

A. 01140 – Coordination and Permitting

B. 02510 – Water Pipelines

C. 02900 - Landscaping

PART II MATERIALS AND EQUIPMENT

2.01 FILL MATERIAL

All fill material shall conform to City Utilities' Construction Standards and is subject to approval of the Resident Engineer.

2.02 STANDARD BACKFILL MATERIAL - NO EXTRA GRANULAR MATERIAL REQUIRED

Other than pipe bedding, backfill with suitable materials excavated from trench and processed as required, or borrowed from locations arranged and paid for by Contractor. Material shall be free from organic matter, refuse, ashes, cinders or other unsuitable materials, and shall not be frozen. Materials shall be free from gravel, stone or shale particles greater in any dimension four (4) inches. Four inches is the maximum size, in any dimension, of any particle in the backfill and nothing larger will be allowed. Backfill material shall contain sufficient fines to provide a dense mass capable of being compacted.

2.03 NON-STANDARD BACKFILL MATERIAL - GRANULAR MATERIAL REQUIRED

A. Other than pipe bedding and backfill as called out in the applicable Construction Standards, backfill trenches in designated area with 5/8-inch crushed limestone, in accordance with the City of Springfield General Ordinance 02202 even in areas outside of Springfield's city limits.

B. This material will be required under sidewalks, existing paved areas, proposed paved areas, unpaved "driven-over" areas utilized as drives or parking lots, and as necessary on excavations paralleling proposed or existing streets and drives to avoid settlement of curbs or paving.

2.04 PIPE BEDDING MATERIALS

A. Bed all buried pipe with materials indicated on the Drawings as specified below.

B. Granular Pipe Embedment

1. Material: Crushed limestone

2. Gradation: (5/8" Commercial Aggregate)

Percent Passing	Sieve
100	5/8"
70-90	1/2"
0-10	No. 4

3. Soundness: Loss of Less than 15% after five cycles when tested with sodium sulfate in accordance with AASHTO T104.

C. Sand Pipe Embedment

1. Material: Crushed limestone Sand

2. Gradation: 100% passing No. 4 sieve

PART III EXECUTION

3.01 TRENCHING

A. Centerline: Maintain centerline of the trench in a straight line with minimum bends or changes in direction. When trenching in pavement, saw cut the pavement in a straight line on both sides of the future excavations.

B. Length:

1. Minimize the amount of open trench and do not exceed 250' in length at any time on the same street. Fill trenches as soon as practical after pipe is placed in the ditch and placement and bedding is approved by the

Resident Engineer. Coordinate closing of driveways with the individual property owners. Provide adequate access to all businesses during their operating hours.

C. Width:

1. Maintain width of trench ample to permit pipe to be laid and jointed properly, and backfill to be placed and compacted as specified.

2. Remove ledge rock, boulder and large stones to provide a clearance of at least six inches below and on each side of all pipe, valves and fittings for pipes.

D. Depth: Depth shall be as follows, unless shown otherwise on the drawings. Measurements shall be made from the low side of the trench. Note where ditch depths greater than the minimum are required.

1. Water Mains: Excavate trench to allow a minimum of 48 inches to top of water pipe from finished grade.

2. Water Services: Excavate trench to allow a minimum of 42 inches of cover to top of water pipe from finished grade.

E. Adjacent Structures, Water, Sewer, Gas Line and Telephone Cable Crossings:

1. Follow such method of course as may be approved by Resident Engineer in passing all underground structures.

2. Exercise extreme care in crossing or paralleling water, sewer, gas lines and telephone cables. Cross or parallel all structures at Contractor's sole risk and responsibility. Should any damage occur to such lines, Contractor is fully liable and will pay full cost of repairing same.

3. Make all arrangements and pay for relocation and bracing where poles or anchors are affected by the trenching operation.

F. Foundation for Pipe:

1. Grade the trench bottom as required to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed earth free from rock points throughout the length of pipe. Finish subgrade to a straight line between pipe joints.

2. Place, grade and compact to a uniform depth a minimum of six inches of specified bedding material in the ditch bottom prior to placing any pipe in the ditch.

3. Where trench excavation is inadvertently carried below specified grade, backfill with approved material in 3-inch layers thoroughly compacted to provide a firm and unyielding subgrade.

4. Where the bottom of trench at subgrade is found to be unstable or include ashes, cinders, refuse or other organic material, excavate and remove such unsuitable material and fill according to Item 3, above.

G. Trench Bracing and Shoring: Adequately support all trenches in strict accordance with all pertinent and applicable codes, rules and regulations.

H. Protect the public from any excavations left open during times when Contractor is not working.

3.02 SPOIL AREAS

A. Complete removal of excess earth, rock and debris from the site immediately upon completion of each day's work. Minimize the amount of spoil in the easements and right-of-ways at all times. Store no spoil off the right-of-ways or easements unless prior written permission has been obtained from the property owner.

B. Locate and maintain off-site spoil areas for excess excavated materials. Restore these areas to satisfactory condition before final payment is approved. Provide a certificate of acceptance from the owner of the spoil area, if requested by the Resident Engineer.

3.03 PIPE BEDDING

A. Water Mains and Services: Embed pipe with crushed limestone or limestone sand from a minimum of six inches below the pipe to six inches above the pipe. Place a minimum of six inches of sand or crushed limestone on each side of the pipe. Compact to provide for lateral support of pipe.

3.04 BACKFILL AND COMPACTION

A. General: Do not backfill trench until work is inspected and approval to proceed with backfill has been given by the Resident Engineer. Complete backfilling promptly after approval to proceed.

B. Do not use compactors which could result in damage to the buried pipe.

C. In areas of standard backfill, fill trench above pipe embedment level with approved excavated materials. Compact as necessary to avoid settlement of ditch line. Fill any settled areas for a period of one year after date of acceptance by City Utilities.

D. In areas of non-standard backfill (paved or other designated areas), fill trench above pipe embedment level with approved granular material. Fill any settled areas for a period of one year after date of acceptance by City Utilities. Restore surface as needed.

E. Install locator wires (where required) before backfilling.

F. Install warning tape above water piping per City Utilities' standards.

3.05 ROCK EXCAVATION

A. All blasting is performed at the Contractor's sole risk. The Contractor is solely responsible for any and all damages caused by blasting to any adjacent structure or any other underground facilities. If damage does occur to any above or below ground facilities, including other City Utilities facilities, the Contractor is fully liable.

B. All excavation is considered unclassified. Presence of rock shall not relieve Contractor of depth requirements given in paragraph 3.01. There shall be no change in the Contract Price due to rock, regardless of type or hardness.

C. In high hazard areas, remove rock by jackhammering as necessary. Make determination of whether or not rock can be blasted, but Contractor shall be fully liable for any damages.

D. Perform all blasting in accordance with the City of Springfield's General Ordinance #4714, even for areas outside the jurisdiction of the City of Springfield. Only persons holding blasting licenses as issued by the Springfield Fire Department may perform blasting. Obtain the necessary blasting permits.

3.06 OPEN CUTTING ROADWAYS

Open cut roadways only as approved by the governing authority. If approval to open cut is not received, roadways must be bored

END OF SECTION

SECTION 02900
LANDSCAPING

PART I. GENERAL

1.01 Work Included: Furnish all labor, materials, and equipment necessary for any landscaping work required by the Contract Documents. Such work includes, but is not limited to, performing preliminary cleanup and applying topsoil to areas disturbed by Contractor activities and areas disturbed by stored materials associated with this Contract. The Resident Engineer will designate disturbed areas that need to be seeded and landscaped.

1.02 Guarantee and Acceptance: The Contractor shall guarantee a uniform stand of grass by seeding in all seeded areas that is capable of resisting erosion and is reasonably free of weeds.

PART II. MATERIALS AND EQUIPMENT

2.01 Topsoil:

A. Fertile, friable soil of loamy character, free of sub-soil, stumps, refuse, and other foreign material.

B. Normal amount of natural humus and reasonably free of roots, hard dirt, heavy or stiff clay, coarse sand, noxious weeds, noxious weed seeds, sticks, brush, and other litter.

C. Obtained from well-drained, arable land, and be of an even texture.

D. Not infested with nematodes nor with any other noxious animal life or toxic substances.

E. Sandy loam of low fertility, even though mixed with leaf mold, manure, or other fertilizers is not acceptable.

2.02 Grass Seed:

A. Clean, dry, new crop seed.

B. Provide grass seed for established areas in a blend as specified below, unless directed otherwise by the Resident Engineer:

1. 75% by weight of a three-way blend (equal parts) of turf fescues, consisting of any three of the following varieties: Olympic, Falcon, Bonanza, Rebel, Hound Dog, Astro 2000, Eldorado, Wrangler, FineLawn One, Anthem, or Apache.

2. 15% by weight of Perennial Rye, consisting of one or more of the following varieties: Affinity, Derby, Regal, Manhattan, or Chateau.

3. 10% by weight of Bluegrass, consisting of either Kentucky Bluegrass, Park Bluegrass, or both.

4. Purity 98%.

5. Germination 85%.

C. Complies with standards of the Official Seed Analysis of North America.

D. Recommended for full sun exposure in Springfield, Missouri.

E. Seed shall be free from Johnson Grass, Canadian Thistle, or field bind weed seed.

F. As approved by Resident Engineer.

2.03 Fertilizer: Provide a mixture containing 13 pounds each of soluble nitrogen, phosphate, and potash per 100 pounds. Clean wheat straw shall be material applied over the hydraulic mulch.

2.04 Mulch for Hydraulically Seeded Areas:

Provide a mixture of 50% recycled slick paper mulch and 50% ground corrugated paper mulch by weight. The recycled slick paper mulch shall be produced from printers slick paper containing wood cellulose and kaolin clay. Newsprint is not allowed. The slick paper mulch shall have a maximum moisture content of 8% by weight, and shall have a pH of 4.5 to 6.5. The corrugated paper mulch shall have a moisture capacity of 700 grams water per 100 grams dry mulch minimum, a dry moisture content of 12% maximum, and a pH of 5.0 - 8.0. All mulch materials must be free of any germination or growth-inhibiting substances, green in color, and have the property of being evenly dispersed and suspended when agitated in water.

Clean wheat straw shall be material applied over the hydraulic mulch.

PART III. EXECUTION

3.01 Preliminary Cleanup:

Clear disturbed areas, including those disturbed by trenching, storing of dirt, pipe laying, pipe storage, movement of equipment, and other work of all rubbish, brush, rock, trash, and excess dirt in a timely manner as soon as the ditch is backfilled, depending upon existing conditions and level of public concern. This may be required as often as daily. The Resident Engineer will determine an appropriate schedule depending upon job conditions. Rake surface as necessary to remove all above items, including all rock measuring two-inches or more in its greatest dimension. In pasture and cropland areas, remove all above items in a timely fashion. Tractor-drawn equipment, including rock rakes and steel roller drum are allowed.

3.02 Application of Topsoil:

A. Established lawn and parkway areas:

B. After preliminary cleanup has been performed, apply topsoil meeting the requirements of PART II, MATERIALS AND EQUIPMENT to a minimum depth of four inches to disturbed areas. Pulverize topsoil and grade to match existing terrain, or as specified by the Engineer. Rake surface smooth to provide a good seedbed for hydraulic seeding as specified below.

3.03 Seeding: Perform initial seeding as soon as practical after preliminary cleanup and application of topsoil. Seeding windows are specified as follows: Perform autumn seeding between August 15 and October 15, and spring seeding between March 15 and May 15. If initial seeding is performed within either of the specified seeding windows, the only additional work required of the Contractor shall be warranty work. Re-seeding during the next earliest seeding window shall be considered part of the work if initial seeding falls outside either of the specified seeding windows. The Resident Engineer will make the final determination as to need for re-seeding.

A. Hydraulic Seeding: Restore all disturbed areas by hydraulic seeding. Mix seed, fertilizer, and mulch with water and constantly agitate so that a uniform mixture can be applied hydraulically to the specified areas. Do not add the seed to the water more than four hours before application. Calculate ratios of seed, fertilizer, mulch, and water so that seed will be applied at the rate of twelve pounds minimum per 1000 square feet of area, fertilizer will be applied at the rate of eight pounds minimum per 1000 square feet of area, and mulch will be applied at the rate of 1000 pounds minimum dry weight per acre. Wet application rate of the mixture shall be 2000 pounds per acre minimum. Blow wheat straw mulch onto the hydraulic mulch within one hour of application of the hydraulic mulch.

END OF SECTION

SECTION 08255
FIBERGLASS REINFORCED POLYESTER DOORS AND FRAMES

PART I GENERAL

1.01 SECTION INCLUDES

A. Fiberglass reinforced polyester (FRP) flush doors with FRP frame

B. Fire rated Fiberglass reinforced polyester (FRP) flush doors with stainless steel frame

1.02 REFERENCES

A. AAMA 1503-98 • Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.

B. ANSI A250.4 • Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing.

C. ASTM B 117· Operating Sail Spray (Fog) Apparatus.

D. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.

E. ASTM B 221 • Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

F. ASTM D 256 - Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.

G. ASTM D 543 - Evaluating the Resistance of Plastics to Chemical Reagents.

H. ASTM D 570· Water Absorption of Plastics.

I. ASTM D 638 • Tensile Properties of Plastics.

J. ASTM D 790 • Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

K. ASTM D 1308 • Effect of Household Chemicals on Clear and Pigmented Organic Finishes.

L. ASTM D 1621 - Compressive Properties of Rigid Cellular Plastics.

M. ASTM D 1623 • Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.

N. ASTM D 2126· Response of Rigid Cellular Plastics to Thermal and Humid Aging.

O. ASTM D 2583· Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

P. ASTM E 84 - Surface Burning Characteristics of Building Materials.

Q. ASTM E 90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

R. ASTM E 283 - Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

S. ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

T. ASTM E 331 - Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

U. ASTM F 476 - Security of Swinging Door Assemblies.

V. SFBC PA 201 - Impact Test Procedures.

W. SFBC PA 203- Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.

X. SFBC 3603.2 (b) (5) - Forced Entry Resistance Test.

1.03 PERFORMANCE REQUIREMENTS NON-RATED DOOR

A. General: Provide door assemblies that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturer's corresponding standard systems.

B. Air Infiltration: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 283 at pressure differential of 6.24 psf. Door shall not exceed 0.90 cfm per linear foot of perimeter crack.

C. Water Resistance: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 331 at pressure differential of 7.50 psf. Door shall not have water leakage.

D. Hurricane Test Standards, Single Door with Single-Point Latching:

1. Uniform Static Load, ASTM E 330: Plus or minus 75 pounds per square foot.
2. Forced Entry Test, 300 Pound Load Applied, SFBC 3603.2 (b)(5): Passed.
3. Cyclic Load Test, SFBC PA 203: Plus or minus 53 pounds per square foot.
4. Large Missile Impact Test, SFBC PA 201: Passed.

E. Swinging Door Cycle Test, Doors and Frames. ANSI A250.4: Minimum of 20,000,000 cycles.

F. Swinging Security Door Assembly. Doors and Frames, ASTM F 476: Grade 40.

G. Salt Spray, Exterior Doors and Frames, ASTM B 117: Minimum of 500 hours.

H. Sound Transmission. Exterior Doors, STC, ASTM E 90: Minimum of 25.

I. Thermal Transmission, Exterior Doors, U-Value, AAMA 1503-98: Maximum of 0.29 BTU/hr)(sf x degrees F. Minimum of 55 CRF value.

J. Surface Burning Characteristics, FRP Doors and Panels, ASTM E 84:

1. Flame Spread: Maximum of 200, Class C.
2. Smoke Developed: Maximum of 450, Class C.

K. Surface Burning Characteristics, Class A Option On Interior Faces of FRP Exterior Panels and Both Faces of FRP Interior Panels, ASTM E 84:

1. Flame Spread: Maximum of 25.
2. Smoke Developed: Maximum of 450.

L. Impact Strength, FRP Doors and Panels, Nominal Value, ASTM 0256: 15.0 foot-pounds per inch of notch.

M. Tensile Strength, FRP Doors and Panels, Nominal! Value, ASTM D 638: 14,000 psi.

N. Flexural Strength, FRP Doors and Panels, Nominal Value, ASTM D 790: 21,000 psi.

O. Water Absorption, FRP Doors and Panels, Nominal Value, ASTM 0 570: 0.20 percent after 24 hours.

P. Indentation Hardness, FRP Doors and Panels, Nominal Value, ASTM 02583: 55.

Q. Abrasion Resistance, Face Sheet, Taber Abrasion Test, 25 Cycles at 1,000 Gram Weight with CS-17 Wheel: Maximum of 0.029 average weight loss percentage.

R. Stain Resistance, ASTM 0 1308: Face sheet unaffected after exposure to red cabbage, tea, and tomato acid. Stain removed easily with mild abrasive or FRP cleaner when exposed to Sharpie ink pen and white spray paint

S. Chemical Resistance, ASTM D 543. Excellent rating.

1. Acetic acid, 5 percent solution.
2. Chlorine bleach, 10 percent solution,
3. Sodium hypochlorite, 4 to 6 percent solution.
4. Citric acid, 10 percent solution.
5. Sodium carbonate, 20 percent solution.
6. Turpentine.

T. Compressive Strength, Foam Core, Nominal Value, ASTM 0 1621: 84.2 psi.

U. Compressive Modulus, Foam Core, Nominal Value, ASTM D 1621: 448 psi.

V. Tensile Adhesion, Foam Core" Nominal Value, ASTM 01623: 48 psi.

W. Thermal and Humid Aging, Nominal Value, 158 Degrees F and 100 Percent Humidity for 14 Days, ASTM 02126: Minus 4.89 percent volume change.

1.04 SUBMITIALS

A. Comply with Section 01330 - Submittal Procedures.

B. Product Data: Submit manufacturer's product data, including description of materials, components, fabrication, finishes, and installation.

C. Shop Drawings: Submit manufacturer's shop drawings, including elevations. sections, and details, indicating dimensions, tolerances, materials, fabrication, doors, panels, framing, hardware schedule, and finish.

D. Samples:

1. Door: Submit manufacturer's sample of door showing face sheets, core, framing, and finish.

2. Color: Submit manufacturer's samples of standard colors of doors and frames.

E. Test Reports: Submit certified test reports from qualified independent testing agency indicating doors comply with specified performance requirements.

F. Manufacturer's Project References: Submit list of successfully completed projects including project name and location, name of architect, and type and quantity of doors manufactured.

G. Maintenance Manual: Submit manufacturer's maintenance and cleaning instructions for doors, including maintenance and operating instructions for hardware.

H. Warranty: Submit manufacturer's standard warranty.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Continuously engaged in manufacturing of doors of similar type to that specified, with a minimum of 25 years successful experience.

2. Door and frame components from same manufacturer.

3. Evidence of a compliant documented quality management system.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying opening door mark and manufacturer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

C. Handling: Protect materials and finish from damage during handling and installation

1.07 WARRANTY

A. Warrant doors, frames, and factory applied hardware against failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in excess 01 normal weathering.

1. Warranty Period: Ten years starting on date of shipment.

B. Warrant door corner failure, face sheet delamination or bubbling, and core deterioration

1. Warranty Period: Lifetime

PART II MATERIALS AND EQUIPMENT

2.01 MANUFACTURER

A. Special-lite, lnc., PO Box 6, Decatur, Michigan 49045. Toll Free (800) 821·6531.

Phone (269) 423-7068. Fax (800) 423-7610. Web Site www.special-lite.com.

B. Approved Manufacturers

1. US Aluminium

2. Vistawall

2.02 FRP FLUSH DOORS

A. Model: SL-17 Flush Doors with SpecLite3 fiberglass reinforced polyester (FRP) face sheets.

B. Door Opening Size: As indicated on the Drawings and Door Schedule.

C. Construction:

1. Door Thickness: *1-3/4* inches.

2. Stiles and Rails: Aluminum Alloy 6063-T5, minimum of 2-5/16·inch depth.

3. Corners: Mitered.

4. Provide joinery of 3/B-inch diameter full-width tie rods through extruded splines top and bottom as standard tubular shaped stiles and rails reinforced to accept hardware as specified.

5. Securing Internal Door Extrusions: 3/16·inch angle blocks and locking hex nuts for joinery. Welds, glue, or other methods are not acceptable.

6. Furnish extruded stiles and rails with integral regrets to accept face sheets. Lock face sheets into place to permit flush appearance.

7. Rail caps or other face sheet capture methods are not acceptable.

8. Extrude top and bottom rail legs for interlocking continuous weather bar.

9. Meeting Stiles: Pile brush weatherseals. Extrude meeting stile to include integral pocket to accept pile brush weatherseals.

10. Bottom of door to have adjustable door bottom SL-301.

D. Face Sheet:

1. Material: SpecLite3 FRP, 0.120~inch thickness, finish color throughout Abuse-resistant engineered surface.

2. Texture: Pebble.

3. Color: As selected by Architect from manufacturer's standard 14 colors.

E. Core:

1. Material: Poured-in-place polyurethane foam.

2. Density: Minimum of 5 pounds per cubic foot.

3. R-Value: Minimum of 9.

F. Cutouts:

1. Manufacture doors with cutouts for required vision lites, louvers, and panels.

2. Factory install vision lites, louvers, and panels.

2.03 DOOR FRAMES

A. Exterior & interior Material: *1/4* inch thick solid pultruded FRP profiles having no corrosive components or reinforcement.

1. Width: 2 inch faces.

2. Depth: *5-3/4* inch standard

3. Style: One piece chemically welded at factory

4. Door Stop: *1/2* inch x *2-114* inch.

5. Corner Construction: Mitered with 4 inch x 4 inch x 3/8 inch pultruded FRP angle reinforcement with interlocking "L" shaped pultruded FRP brackets.

6. Reinforcing: *5/16* inch pultruded FPR chemically welded at all hinge, strike & closer locations.

7. Anchors: Furnished with 6 total wall anchors

8. Fasteners: Type 304 CRSS (18-8 series corrosion resistant stainless steel.

9. Finish: selected from manufacturers standard; 4 colors.

2.04 FINISH OF DOORS

A. Face sheet colors to be selected from manufacturers standard 14 colors.

2.05 FABRICATION

A. Sizes and Profiles: Required sizes for door and frame units, and profile requirements shall be as indicated on the Drawings.

B. Coordination of Fabrication: Field measure before fabrication and show recorded measurements on shop drawings.

C. Assembly:

1. Complete cutting, fitting, forming, drilling, and grinding of metal before assembly.

2. Remove burrs from cut edges.

D. Welding: Welding of doors or frames is not acceptable.

E. Fit:

1. Maintain continuity of line and accurate relation of planes and angles.

2. Secure attachments and support at mechanical joints with hairline fit at contacting members.

2.06 HARDWARE

A. Pre-machine doors in accordance with templates from specified hardware manufacturers and hardware schedule.

B. Factory install hardware.

1. Hinges: [SL-11HD continuous hinges] or approved equal.

2. Locking Hardware: Schlage ND Series Grade 1 Lever handles with deadbolt or approved equal. Locks to be keyed to match city utilities Water Department key.

3. Door closers are required on exterior and interior doors and shall be LCN 4041XT with hold open capability or approved equal.

4. Concealed adjustable bottom brush. Install door manufacturer's multidirectional adjustable bottom with double nylon brush weather stripping. Door bottom must be concealed and adjust to accommodate irregular tapered floor conditions.

2.07 VISION LITES

A. Factory Glazing: 1/4-inch or 1 inch glass for exterior doors.

B. Lites in Exterior Doors: Allow for thermal expansion.

C. Rectangular Lites:

1. Size: As indicated on the Drawings.

2. Factory glazed with screw-applied aluminum stops anodized to match perimeter door rails.

PART III EXECUTION

3.01 EXAMINATION

A. Examine areas to receive doors. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Ensure openings to receive frames are plumb, level, square, and in tolerance.

3.03 INSTALLATION

A. Install doors in accordance with manufacturer's instructions.

B. Install doors plumb, level, square, true to line, and without warp or rack.

C. Anchor frames securely in place.

D. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by Architect.

E. Set thresholds in bed of mastic and backseat.

F. Install exterior doors to be weathertight in closed position.

G. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Resident Engineer.

H. Remove and replace damaged components that cannot be successfully repaired as determined by Resident Engineer.

I. Provide and install stainless steel doorknobs with the exteriors keyed to City Utilities' Water Department standard key system.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for installation of doors.

3.05 ADJUSTING

A. Adjust doors, hinges, and locksets for smooth operation without binding.

3.06 GLEANING

A. Clean doors promptly after installation in accordance with manufacturer's instructions.

B. Do not use harsh cleaning materials or methods that would damage finish.

3.07 PROTECTION

A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 09900
PAINTING

PART I. GENERAL

1.01 Work Included: Furnish all labor, materials, and equipment necessary for the shop surface preparation and painting and the field surface preparation and painting of the tank as specified herein. Steel tank painting shall comply with AWWA D102 and NSF 61.

1.02 Storing and Handling Materials: Store materials in a place assigned by the Resident Engineer. Keep area clean, remove all oily rags and waste at the end of each working day. Upon completion of the work, containers, rubbish, and accumulated materials of every kind caused by work under this section shall be removed from the premises.

1.03 Workmanship: The object of these specifications is to provide the material and workmanship necessary to produce a top-quality job. Employ only skilled mechanics employed for the particular work involved. Apply materials to produce even, thorough coats, without runs, sags, or other blemishes, according to the material manufacturer's recommendation. Protect all surfaces and objects against spattered paint and all other damage. Damage shall be repaired.

The Owner reserves the right to have a representative (independent consulting/testing firm) present during all or part of the time that field surface preparation and painting work is being done. The Contractor shall assist the Owner and the Owner's representative in making direct observation of the work. The Contractor shall provide in written notice to the Owner and the Owner's representative at least two weeks prior to the start of the work.

1.04 Colors: The color of the interior and exterior shall be white.

1.05 Warranty:

A. The Contractor shall warrant and guarantee that the materials and workmanship furnished under this contract shall be as specified and shall be free form defects for a period of two years from the date of final payment for work covered under this contract.

B. Within the guarantee period and upon notification of the Contractor by the owner, the Contractor shall promptly make all needed adjustments, repairs, or replacements arising out of defects which, in the judgment of the Owner, and/or Owner's representative, become necessary during such period. The cost of all materials, parts, labor, transportation, supervision, special tools and supplies required for adjustments, repairs of replacements shall be paid for by the Contractor, or by his surety under the terms of the Performance and Payment Bonds.

C. The Contractor also extends the terms of this guarantee to cover repair work and all replacement parts furnished under the guarantee provisions for a period of two years from the date of final payment.

D. The coatings will be inspected one month prior to the two year warranty expiration to assure that no coating failure has occurred. If any corrosion, bubbling, delaminating or other indications of failure are detected, the Contractor shall repair all affected areas (see 1.06 below Second Year Anniversary Inspection). Inspection and repair will be in accordance with AWWA D102.

E. In addition to the Contractor's warranty and guarantee period, the Contractor shall warrant through the Manufacturer that the exterior coating system shall not:

1. Check, crack, blister or delaminate from the substrate.

2. Allow the substrate to corrode in excess of 1% of the surface area being coated and measured in accordance with ASTM D610-95 "Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces" for a period of five (5) years from substantial completion date or corrode in excess of an additional 0.5% per year for balance of the warranty coverage period.

3. Change color more than 5 DE Hunter units as determined in accordance with ASTM D2244 by comparing the affected exposed coating cleaned with water and a soft cloth with unexposed Original Project Color Standards maintained by the paint manufacturer and the Owner.

4. Exhibit loss of gloss in excess of 24 units as measured by a gloss meter in accordance with ASTM D523-89 with 60 degree geometry.

5. Chalk in excess of a rating of 8 as measured in accordance with ASTM D4214, Method A.

6. Warranty coverage shall be effective for a period of 15 years from the final payment. The Contractor shall notify the Manufacturer prior to ordering material and begin the warranty process. Sample panels shall be obtained from the Manufacturer, and at least 2 samples panels shall be provided to the Owner in addition to the Manufacturers minimum requirements regarding the warranty process. The Contractor shall not be permitted to install the coating system until the Manufacturer has provided assurance that the color, substrate, surface preparation or existing conditions are in conformance with the Manufacturer's requirements for a warranty.

1.06 Second Year Anniversary Inspection:

Second Year Anniversary Inspection shall be performed. The CONTROCTOR'S Performance Bond or a separate Maintenance Bond shall be in force until after any remedial work is performed. The CONTRACTOR shall perform the following duties at the Second Year Anniversary Inspection:

A. The CONTRACTOR shall perform the inspection, and shall furnish an experienced foreman, laborer, and rigging for the inspection.

B. Washout: The CONTRACTOR shall washout the interior of the tank for the second year evaluation the day prior to the evaluation. All debris from the interior

of the container shall be legally disposed of by the CONTRACTOR at no additional cost to the OWNER.

C. The CONTRACOR shall be prepared to perform minor touch-up operations.

D. The CONTRACTOR shall have at least one gallon of each of the interior primer, intermediate coating, and finish coating at the time of the inspection along with power cleaning tools and "Scotch-Brite" abrasive disks for spot cleaning.

E. The CONTRACTOR shall also have at least one new, unopened, quart kit of touch up repair kit compatible with the coating selected. Tnemec series FC22 touch up kit or AquataPoxy A-6 Paint (manufactured by Raven Lining Systems, Tulsa, Oklahoma, telephone 800-324-2810) to touch up the interior surfaces. The FIELD OBSERVER shall determine if the coating failures are extensive enough to require the use of the specified epoxy coatings to touch up the interior surfaces.

F. REPAIRS: Spot repairs shall be made by the CONTRACTOR before returning the tank to service. Repairs requiring extensive Work and rigging may be delayed until a time mutually agreeable to the OWNER and CONTRACTOR.

G. Disinfection: It is the CONTRACTOR'S responsibility to disinfect the tank in accordance with AWWA C652-02 until two consecutive satisfactory water samples are reported from the OWNER'S selected laboratory.

H. Costs: All cost associated with the Second Anniversary Inspection, including the wash-out and disinfection, shall be included in the Base Bid price. The performance of this inspection and/or any remedial work shall not relieve the CONTRACTOR of any responsibility for defects in materials or workmanship that may or may not be evident during the anniversary inspection.

I. Date of Inspection: Failure of OWNER to establish a Second Year Anniversary Inspection date will not relieve the CONTRACTOR of the responsibility to inspect and perform repair on the interior and interior dry coating system.

PART II. MATERIALS

2.01 Acceptable Manufacturers: Acceptable coating manufacturer's follow; however, the Contractor is advised that all manufacturers presented below must certify that the coatings furnished are in compliance with these specifications. All paint systems shall comply with AWWA D102-14

A. Exterior Surfaces:
Any paint used for the exterior surfaces shall contain less than 100 milligrams of lead per kilogram of dried paint.

a. Tnemec Company, Inc., Kansas City, MO 64141

(1)	Series 91 H20 Hydro-Zinc	2.5 – 3.5 mils
(2)	Series 73 Endura Shield	2.0 – 3.0 mils
(3)	Series 700 Hydro Flon	2.0 – 3.0 mils
	Total System Dry Thickness	6.5 – 9.5 mils

b. Induron Coating, Inc., Birmingham, AL 35201

(1)	Induraguard SG Epoxy MC7 Indurazinc	2.5 – 3.5 mils
(2)	6700 Indurethane	2.0 – 3.0 mils
(3)	Permagloss Fluorourethane	2.0 – 3.0 mils
(4)	Total System Dry Thickness	6.5 – 9.5 mils

B. Interior Surfaces:
Acceptable coating manufacturers and specifications for the interior surfaces of the steel water storage tank follow, and are intended to comply with the requirements of AWWA D102- Inside System No. 3, Ultra High Solids Medium Film Coating Epoxy systems. A primer coat is acceptable provided it is compatible with the finish coat. All interior paint systems shall be certified for drinking water use under the latest ANSI/NSF Standard 61.

a. Tnemec Company, Inc., Kansas City, MO 64141

Shop primer:	91H2O Tneme-Zinc	2.5 – 3.5 mils
(1)	Series 22 Epoxiline or FC 22	16.0 – 22.5 mils
	Total System Dry Thickness	18.5 – 26.0 mils

b. Induron Coating, Inc., Birmingham, AL 35201

(1)	Perma-Clean 100	20. – 25 mils
	Total System Dry Thickness	20 – 25.0 mils

2.02 If thinning is necessary, use only the products of the manufacturer furnishing the paint, and for the particular purpose, according to the manufacturer's instructions, and with the approval of the Resident Engineer.

2.03 Finish field coats shall be compatible with shop applied prime painting.

2.04 Sandblasting media shall be Reed Materials “Black beauty” or equal.

PART III. EXECUTION

3.01 Surfaces shall be clean, smooth, dry and free from foreign material before application of finish. If any surface cannot be put in proper condition for finishing by the customary cleaning, sanding, brushing, and filling operations, notify the Resident Engineer in writing. The Contractor is responsible for the condition of surfaces. Rectify any unsatisfactory finish resulting from improper surface conditions.

3.02 **Exterior Surfaces:** The exterior surfaces shall be cleaned to a degree of cleanliness equivalent to SSPC-SP 6, Commercial Blast Cleaning (modified) by method approved by the Owner and Owner’s representative.

A. **Prime Coat:** Not later than during the same day and before the forming of rust, the cleaned surfaces (SSPC-SP 6) shall be primed with the specified primer.

1. **Stripe Coat:** After the application of the prime coat, all seams, edges, riser rods, lapped joints, rough areas, bolt heads and nuts, corners, member intersections, and other deviations from smooth surfaces shall be primed by brush and/or roller using a 10% thinned material in a contrasting color to the primer. The 10% thinned material shall be worked sufficiently into all cracks, crevices, and seams. Initial spray application of the stripe coat shall not be permitted.

2. **Intermediate Coat:** The intermediate coat shall differ from the prime coat and shall be slightly darker than that chosen for the finish coat, being dark enough to visually assure application of the finish coat, and light enough to allow proper hiding. (An intermediate coat lighter than the finish coat shall not be permitted due to the inability to distinguish between the lighter intermediates and the highlights of the gloss finish). The coating manufacturer shall recommend a darker color for the intermediate coat and this color shall be submitted for review.
3. **Finish Coat:** The finish coat shall then be applied in a color selected by the Owner.

3.03 **Interior Surfaces:** All interior surfaces including (but not limited to) the roof, shell, bottom, manholes, bolts, nuts, pins, brackets, seams, corners, etc. shall be cleaned and painted in accordance with this section. The interior surfaces shall be cleaned to a degree of cleanliness equivalent to SSPC – SP 10, Near-White Blast Cleaning (modified) by a method approved by the Owner and the Owner's representative.

A. **Prime Coat:** Before the formation of rust and after observation by the Owner/Owner's representative, all cleaned surfaces shall be primed with the first coat as specified.
   1. **Stripe Coat:** After the application of the first coat, all seams, edges, riser rods, lapped joints, rough areas, bolt heads and nuts, corners, member intersections, and other deviations from smooth surfaces shall be primed by brush and/or roller using a 10% thinned material in a contrasting color to the primer. The 10% thinned material shall be worked sufficiently into all cracks, crevices, and seams. Initial spray application of the stripe coat shall not be permitted.
   2. **Intermediate Coat:** After the recommended drying period of the prime coat and stripe coat, a full intermediate coat shall be applied.
   3. **Finish Coat:** After the recommended drying period of the prime coat stripe coat and intermediate coat, a second full finish coat shall be applied.

B. The interior paint shall be completely cured and the tank shall not be filled with water until approved by the Owner and paint manufacturer. Solvent rub tests, pencil hardness tests, or other industry recognized testing procedures may be used to verify curing and solvent release. If temperature and humidity conditions during curing are not as published in the paint manufacturer's standard instructions, equivalent times at the recorded conditions shall be furnished and certified by the paint manufacturer (not sales representative). The Contractor shall furnish ventilation equipment to expel solvents from the interior of the painted steel tank during the curing process at no additional cost to the Owner. Interior paint systems shall be properly applied and cured and shall not transfer any substance to the water that results in a violation of a MCL or secondary containment level. Curing should be done to eliminate tastes and odors. After painting and proper curing are completed and the tank is filled, the water that exhibits such odors shall be tested for each paint constituent that is listed in Missouri 10 CSR 60, Chapter 4 prior to placing the tank is service.

C. The approval of potable water tank interior coatings and sealers shall be based on written certification of compliance with ANSI/NSF Standard 61 and compliance with the requirements of state agencies. Adequate manufacturer's published product data concerning the transportation, storage, mixing, thinning, pot life, application,

and curing shall be furnished to ensure that the finished product complies with ANSI/NSF Standard 61.

D. Adequate illumination shall be provided while work is in progress, including explosion proof lights and electrical equipment. Temporary ladders and scaffolding shall conform to OSHA safety requirements. They shall be erected to facilitate inspection and moved by the Contractor as required.

3.04 Perform no painting when the temperature is below 50 degrees F or above 120 degrees F, upon wet or frosty surfaces, or in a damp atmosphere except by permission of the Resident Engineer, and in the manner that the Resident Engineer may approve. Provide heat and ventilation to keep surfaces to be painted dry and warm until the paint has hardened. Should any painting application be performed at lower than 50 degrees F, a the Tnemec product may be used with a series 44-700 accelerator.

3.05 Previous coats of paint must be dry before application of succeeding coats. Tint each coat of paint to make it distinguishable from succeeding coats. Allow Resident Engineer to inspect and approve each coat of material before application of succeeding coats; otherwise, no credit for coat applied will be given and the work in question shall be recoated.

3.06 Surfaces which are galvanized, items of stainless steel, copper, mechanical equipment and electrical equipment which have been furnished with baked-on enamel or porcelain, laminated plastic or similar finish, are NOT to be painted, unless particularly specified otherwise.

3.07 During the work and upon completion, re-touch painted areas where necessary and clean off paint spots from floors, walls, doors, louvers, frames, finish hardware, equipment, etc., and leave all surfaces in a clean and satisfactory condition as required by the Resident Engineer.

3.08 Paint dry film thickness readings shall be taken in accordance with SSPC – PA2. The thickness of each type of coating is essential to the system integrity. The addition of mils in a succeeding coat to make up for thin preceding coat(s) shall not be allowed except where required to hide the underlying darker color(s). Dry mil thickness thicker than the specified allowable shall also not be considered to be in conformance with the specification if it shall be detrimental to the appearance, life, or recoatability of the system.

3.09 Interior coatings above and below the high water level shall be checked with a non-destructive, wet sponge low voltage holiday detector and testing shall be done in accordance with Section 5.1.3 of AWWA D102 and NACE SP0188. The Contractor shall furnish the holiday detection equipment and perform the tests in the presence of the Owner/Owner's representative. Should any defects become apparent, the voids indicated shall be repaired by applying additional coatings of the specified finish coat for the respective coating system by brush or roller. The areas shall be retested after the appropriate drying time as indicated by manufacturer's technical data and recommendations. The coating system must pass the holiday test regardless of the mil thickness existing.

END OF SECTION

SECTION 11268
RESERVOIR HYDRODYNAMIC MIXING SYSTEM (HMS)

PART I. GENERAL

1.01 The Contractor shall furnish and install a Hydrodynamic Mixing System (HMS) in the composite elevated water storage tank as specified herein, as generally detailed on the Contract Drawings, and as recommended by the manufacturer.

1.02 The Hydrodynamic Mixing System (HMS) is defined as a supplemental system installed within a potable water storage tank which passively utilizes the energy provided by the inlet water supply and generates a sufficient inlet momentum to achieve a complete homogeneous blending of the water volume within the water storage tank with the inlet supply flow. Determination of complete homogeneous blending shall be defined by the modeling requirements and supporting hydraulic analysis as conducted by each individual HMS manufacturer for their specific system configuration as defined within these specifications. System submittals not providing this validation shall not be considered as a viable HMS and shall not be accepted as an equivalent to this system specification.

1.03 The specifications in this section include all components of the HMS consisting of a bi-directional flow manifold equipped with variable orifice duckbill inlet nozzles and outlet flow check valves that are NSF61 certified. The HMS manufacturer shall be responsible for designing the system in accordance with the hydrodynamic criteria and submit design calculations verifying compliance in accordance with the submittal requirements.

1.04 All modeling and hydraulic and mixing calculations pertaining to the HMS shall originate from the duckbill manufacturer. Modeling and calculations provided by parties other than the duckbill manufacturer are not allowed.

1.05 The Contractor shall be responsible for providing a complete HMS system. The complete HMS system shall be supplied to the Contractor by the variable orifice nozzle manufacturer to maintain single source responsibility for the system. The complete system shall be defined as all piping and appurtenances within the tank downstream of the tank penetration. Appurtenances include pipe, fittings, horizontal and vertical pipe supports, expansion joints, variable orifice duckbill check valves, and any other equipment specified within this section of the specifications. Manufacturer shall be Tideflex Technologies, Carnegie, PA 15106 or approved equal.

1.06 The following describes the design principles of the Hydrodynamic Mixing System and the validation of its effectiveness:

A. To only require one tank penetration for reservoirs that operate in fill-then-draw unless a separate outlet pipe is required. When a separate outlet pipe is required, the HMS shall function as an inlet diffuser.

B. To comprise one manifold pipe with duckbill inlet nozzles and outlet check valves in order to minimize the amount of pipe, fittings and appurtenances required to separate the inlet and outlet.

C. To not have any horizontal piping that requires bracing to the tank shell other than at the bottom of the reservoir.

D. To be passive operating and not require any outside energy source.

E. To utilize the existing differential pressure between distribution system pressure and tank head to fill the reservoir thru the inlet nozzles and draw fluid from the reservoir thru the outlet check valves.

F. To achieve complete mixing via multiple turbulent inlet jets (Jet-induced mixing). Scale modeling has shown that multiple ports provide faster mixing than a single inlet port [Roberts, et al (2005)].

G. To utilize variable orifice inlet nozzles that provides a non-linear jet velocity vs. flow characteristic. This maximizes the inlet momentum at all flow rates. The inlet momentum is the kinetic energy solely responsible for mixing. This also ensures the rise height of negatively buoyant inlet jets will be maximized when the inlet water is colder than the tank water.

H. To have less than ten (10) inlet ports. Scale modeling has shown diminishing returns with greater port quantities [Roberts, et al (2005)].

I. To have inlet ports that discharge an elliptically shaped jet that provides faster mixing and dilution of the inlet water into the tank water.

J. To have outlet check valves separated spatially from the inlet nozzles to mitigate short circuiting.

K. To have a configuration based on Computational Fluid Dynamics (CFD) modeling, conducted by the manufacturer, of a similar configuration in the same tank style.

L. To have multiple sampling studies conducted by water utilities that have conducted “before” and “after” spatial sampling of disinfectant residual and/or temperature that have proven the effectiveness of the HMS. Data can be submitted based upon the request of the engineer.

M. The mixing system is to be sized to provide full storage tank turnover time of approximately 3 days.

N. Fire withdrawal rate: 5,000 (gpm)

1.07 Design Conditions

A. The mixing system is to be sized to provide a full storage tank turnover time of approximately 3 days

B. A net flow rate into the tank during fill periods of up to 1900 gpm and a fire withdrawal rate of 5000 gpm.

1.08 Referenced Publications

Abromaitis, A.T., and Raftis, S.G. (1995). Development and Evaluation of a Combination Check Valve/Flow Sensitive Variable Orifice Nozzle for use on Effluent Diffuser Lines. Water Environment Federation 68th Annual Conference, 1995, Miami Beach, FL.

Barsotti, M.G., Duer, M.J. and Gagne, J. (2003). Investigating a Standpipe Mixing System as a Tool for Managing Retention Time and DBP Formation. AWWA WQTC, Nov. 2003. AWWA, Denver CO.

Champion, R., et al, (1996). Study of Discharge Concentration from Variable Area Nozzles by Planar Laser-Induced Fluorescence. Oregon State University Formal Report. March, 1996.

Duer, M.J., (1998). Use of Variable Orifice Duckbill Valves for Hydraulic and Dilution Optimization of Multiport Diffusers. Water Science and Technology, Vol. 38, No. 10, pp. 277-284.

Duer, M.J., (2003). Use of CFD to Analyze the Effects of Buoyant Inlet Jets on Mixing in Standpipes. *Proc. 2003 AWWA Annual Conference*, Anaheim, CA.

Duer, M.J., (2004). Maintaining Disinfectant Residuals in Distribution Storage Tanks. Presented at 2004 AWWA DSS - Distribution & Plant Operations Conference, Sept. 27, 2004. Chicago, IL.

Grayman, W.M. et al, (2000). Water Quality Modeling of Distribution System Storage Facilities. AWWA, Denver.

Kirmeyer, G.J. et al, (1999). Maintaining Water Quality if Finished Water Storage Facilities. AWWA, Denver.

Knutson, R. (2003). Preventing Water Stagnation in Storage Tanks – Lakeshore Reservoir Case Study. Presented at Washington State Public Utility Water Meeting, Leavenworth, WA. September 2003.

Lee J.H.W., Karandikar J., and Horton, P.R. (1997a). Hydraulics of Duckbill Valve Jet Diffusers. Proc. 13th Australian Coastal and Ocean Engineering Conference, Sept. 1997, New Zealand.

Lee J.H.W., Karandikar J., and Horton, P.R. (1997b). Hydraulics of "Duckbill" Elastomer Check Valves. Journal of Hydraulic Engineering, ASCE.

Nevins, T. (2002). Inlet-Outlet Piping for Circular Distribution Reservoirs. Presented at 2002 PNWS-AWWA Annual Conference. May 3, 2002.

Rossman, L.A. and W.M. Grayman. (1999). Scale-Model Studies of Mixing in Drinking Water Storage Tanks, J.EE, ASCE, Vol. 125, No. 8, August 1999.

Roberts, R., (1998). The Effects of Nozzle Geometry on Jet Mixing. Formal Report on Modeling Conducted at Georgia Institute of Technology.

Roberts, P.J.W., Tian, X., Sotiropoulos, F., and Duer, M.J. (2005). Physical Modeling of Mixing in Water Storage Tanks. Draft Final Report for AwwaRF Project No. E20-J08.

Zavalia, M. and M.J. Duer (2002). Kinney Ave. Water Tank Mixing System – How to Make Good Water Better. Presented at 2002 New England Water Works Association Annual Conference.

1.08 Referenced Standards:

American National Standards Institute (ANSI)

B16.1 – Cast Iron Pipe Flanges and Flanged Fittings

B16.5 – Pipe Flanges and Flanged Fittings

B36.10 – American National Standard Weights and Dimensions of Welded and Seamless Wrought Steel Pipe

American Society for Testing and Materials (ASTM)
A351 – Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
A536 – Standard Specification for Ductile Iron Castings
C110 – Ductile Iron and Gray-Iron Fittings, 3 In. through 48 In. for Water
D1330 – Standard Specification for Rubber-Sheet Gaskets

American Iron and Steel Institute (AISI)
AISI 304 – 304 Stainless Steel Plate

AISI 316 – 316 Stainless Steel Plate

American Water Works Association (AWWA)
C104 – Cement-Mortar Lining of Ductile Iron Pipe and fittings for Water
C110 – Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In. for Water
C115 – Flange Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges

American Water Works Association Research Foundation (AwwaRF)
Project No. E20-J08 – Physical Modeling of Mixing in Water Storage Tanks (Forthcoming)

National Sanitation Foundation (NSF)
NSF Standard 61 – Drinking Water System Components – Health Effects

PART II. MATERIALS

2.01 Individual nozzles and outlet valves shall be packaged separately from the piping equipment.

2.02 All flanges shall be protected by using plastic inserts or plank wood, pipe sections are to be fully supported to prevent pipe deflection or damage to fittings or connections.

2.03 All equipment shall be shipped on pallets capable of fully supporting the pipe sections across their entire length. Pallets should be accessible for fork lift transport or strap and hoist means without causing any load to the pipe equipment.

2.04 All stainless steel components shall be stored separately away from any carbon steel components or other materials that could stain or deface the stainless steel finish from run-off of oxidized ferrous materials.

2.05 All pipe equipment should be covered and stored in areas free from contact with construction site sediment erosion to prevent accumulation of materials within the pipe and fittings.

2.06 Duckbill nozzles should be protected from contact with rigid objects during handling and storage. The Contractor shall be responsible for replacing any duckbill nozzles or elastomeric components that are damaged after arrival on the site through installation and start-up of the system.

2.07 Submittals:

A. *NSF61 Certification*: Copy of the NSF61 Certified Listing for the valves used in the HMS. The valves themselves must be NSF61 certified, not just the elastomer used in construction of the valves. NSF61 approved/certified materials will not be accepted in lieu of valve certification.

B. *Test Report on Elastomer Exposure to Chlorine and Chloramine*: Copy of test report from an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 "Standard Test Method for Rubber Property – Effect of Liquids."

C. *System Installation Drawings*: Engineering installation drawings of the complete manifold piping system as supplied by the manufacturer. These drawings shall include plan view piping arrangement, sections and elevations as required, support bracket installation details, duckbill nozzle orientation details, and all dimensions required for locating the system within the specified dimensions of the tank.

Drawings shall be a minimum of 11 x 17 inches. Five (5) sets of plans shall be provided to the Owner for review and approval in accordance with Section 01330 - SUBMITTALS. Two (2) sets of final fabrication and installation drawings shall be included with the shipment of the manifold piping equipment.

D. *Design Calculations*: All design calculations, curves, and reference information listed below must be submitted by the duckbill valve manufacturer. Calculations, curves, and reference information provided by contractors relating to the HMS are not allowed. The duckbill valve manufacturer MUST include within the submittal package the following design calculations, curves and reference information:

E. Calculations showing the fill time required, under isothermal conditions, for the HMS system to achieve complete mix of the water storage tank volume at minimum, average and peak fill rates. Complete mixing defined as 95% homogenous solution. The theory and equations used in calculating the mixing times must be as described in the Rossman, L.A. and W. M. Grayman (1999) reference.

F. A representative Computational Fluid Dynamics (CFD) model evaluation of the proposed HMS system configuration applied within a water storage tank of similar geometry. Model output documentation shall include all design variables applied for the simulation, plot of the 3-D geometry showing the mesh definition, velocity magnitude vector and contour plots at different cross-sections throughout the water volume, simulated tracer animations showing the spatial and temporal distribution of inlet water in real time during the fill cycle.

G. Hydraulic curves for each inlet nozzle showing headloss, jet velocity, and effective open area all versus flow rate.

H. Hydraulic calculations showing the resulting jet velocities of each inlet nozzle at minimum, average, and peak fill rates.

I. Hydraulic calculations showing the flow distribution among all inlet ports at minimum, average, and peak fill rates.

J. Manifold hydraulic calculations showing the total headloss of the HMS at minimum, average, and peak fill and draw rates. Headloss shall include all minor losses and headloss of nozzles and outlet check valves.

K. Hydraulic curves showing thrust vs. flow for the inlet nozzles.

L. Hydraulic curves for each outlet check valves showing head loss versus flow.

M. If the calculations and supporting data provided do not show compliance with the hydrodynamic requirements of the system as interpreted by the Owner then the submittal shall be rejected.

N. *Installation, Operation and Maintenance Manuals*: Within 30 days of final acceptance of the installation drawings by the Owner, the Contractor shall provide four (4) sets of the installation portion of the Installation, Operation and Maintenance (IOM) Manuals for the applicable system. Within 30 days of final acceptance by the Owner, of the installed system the Contractor shall provide six (6) copies of the complete Installation, Operation and Maintenance (IOM) Manual for final review and approval.

O. The manuals shall be in the following format and include the listed required information as a minimum:

Enclosed in a 3-ring binder with project title and system designation shown on the front cover and side binder.

1. Table of contents

2. Copy of design calculations for the manifold system as defined in the previous section.

3. Copy of complete set of the installation plans.

4. Copy of NSF61 Certified Listing for the valves

5. Parts and equipment list with specification numbers for ordering of replacement parts.

6. Product specification sheets for nozzles, outlet valves, expansion joints, concrete anchors, and any other specialized items supplied with the system.

7. Installation guidelines for the HMS manifold system.

8. Operational procedures for the HMS manifold system.

9. Guidelines for repair of system components.

10. Schedule for suggested periodic maintenance of the manifold system.

2.08 Variable Orifice Duckbill Inlet Nozzles

A. Inlet ports/nozzles shall be duckbill-style check valves that allow fluid to enter the reservoir ring fill cycles and prevent flow in the reverse direction through the nozzle during draw periods. Inlet ports/nozzles may not be fixed-diameter ports or pipes.

B. The duckbill valves shall be NSF61 Certified. NSF61 approved/Certified materials will not be accepted in lieu of valve certification.

C. Inlet ports/nozzles shall have a variable diameter vs. flow hydraulic profile that provides a non-linear jet velocity vs. flow characteristic and a linear headloss vs. flow characteristic. The hydraulic characteristics of the duckbill valves shall be defined by "Hydraulic Code".

D. The inlet ports/nozzles shall discharge an elliptically shaped jet. The nozzle must have been modeled by an independent laboratory using Laser Induced Fluorescence (LIF).

E. Manufacturer shall have conducted independent hydraulic testing to determine headloss and jet velocity characteristics on a minimum of eight (8) sizes of duckbill valves ranging from 2" through 48". The testing must include multiple constructions (stiffness) within each size and must have been conducted for free discharge (discharge to atmosphere) and submerged conditions.

F. Manufacturer shall have conducted an independent hydraulic test where multiple valves (at least four) of the same size and construction (stiffness) were tested to validate the submitted headloss characteristics and to prove the repeatability of the manufacturing process to produce the same hydraulic characteristics.

G. Manufacturer shall have conducted independent hydraulic testing to study the flow distribution characteristics of duckbill valves installed on multiport manifolds.

H. Manufacturer to have conducted Finite Element Analysis (FEA) on various duckbill valves to determine deflection, stress, and strain characteristics under various load conditions. Modeling must have been done for flowing conditions (positive differential pressure) and reverse differential pressure.

I. Manufacturer must have conducted in-house backpressure testing on duckbill valves ranging from ¾" to 48".

J. Manufacturer shall have at least fifteen (15) years experience in the manufacturing of "duckbill" style elastomeric valves.

K. Manufacturer must have duckbill valves installed on manifold piping systems in at least 100 distribution system reservoirs.

L. Manufacturer must have representative inspection videos showing the duckbill valves discharging water into the reservoir during an initial fill (unsubmerged). Manufacturer must also have representative underwater inspection videos showing the operation of the valves when submerged. Representative videos can be submitted upon request from the engineer.

M. The duckbill style nozzles shall be one-piece elastomer matrix with internal fabric reinforcing designed to produce the required discharge velocity and minimum headloss requirements as stipulated in the Submittals section. The flange portion shall be an

N. integral portion of the nozzle with fabric reinforcing spanning across the joint between the flange and nozzle body.

O. The elastomer used in construction of the duckbill valves must have been tested by an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 "Standard Test Method for Rubber Property – Effect of Liquids."

P. The manufacturer's name, plant location, serial number and product part number which designates nozzle size, material and construction specifications shall be bonded onto the surface of the nozzle.

2.09 Outlet Check Valves

A. The outlet flow valves shall be perforated disc type with elastomeric membrane.

1. The valves shall be NSF61 Certified. NSF61 approved/Certified materials will not be accepted in lieu of valve certification.

B. The perforated disc shall be fabricated of stainless steel plate with welded support gussets. The disc shall be flanged and drilled to mate with ANSI B16.1, Class 125/ANSI B16.5 Class 150 flanges. The disc shall have three (3) tapped holes used for fastening the membrane and support rod to the disc with stainless steel bolts, nuts, and lock washers. The top of the disc shall be tapped and supplied with lifting eyebolt for installation.

C. The membrane shall be circular, one piece rubber construction with fabric reinforcement. The diameter of the membrane shall allow adequate clearance between the membrane O.D. and the pipe I.D. The membrane shall be vulcanized with a specified convex radius to produce a compression set to allow the membrane to seal against the perforated disc at low reverse differential pressure.

1. The support rod shall be stainless steel and drilled with three (3) longitudinal holes to allow fastening of rod to membrane and perforated disc.

D. When line pressure inside the valve exceeds the backpressure outside the valve, the line pressure forces the membrane to open, allowing flow to pass through the

perforations in the disc. When backpressure exceeds the line pressure, the membrane seats on the perforated disc preventing backflow.

1. The valve allows flow out of the reservoir during draw cycles and prevents flow into the reservoir during fill cycles.

E. The elastomer used in construction of the membrane must have been tested by an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 "Standard Test Method for Rubber Property – Effect of Liquids."

F. The manufacturer's name, plant location, serial number and product part number which designates membrane size, material and construction specifications shall be bonded onto the surface of the membrane.

2.10 Stainless Steel Pipe and Fittings

A. Stainless steel pipe and fittings shall conform to the associated standards listed in Section 3.0: Reference Standards.

B. Dimensions for stainless steel fittings shall conform to AWWA C110, unless otherwise specified.

C. Piping shall be Schedule 10s stainless steel 304L fabricated from material per ASTM-A240.

D. All flanges shall be plate ring flanges. Flange drilling pattern shall be in accordance with ANSI B16.1/B16.5 standards.

E. Ring flanges shall be continuously welded on both sides.

F. All shop welds shall be manually scrubbed or brushed with non-metallic pads or stainless steel wire brushes to remove weld discoloration. Welds to be chemically passivated with nitric or citric acid.

G. Field welding of stainless steel pipe and fittings will not be allowed unless approved by the Engineer.

2.11 Flange Gaskets

A. Flange gaskets shall be full-faced and shall be in accordance with ASTM D1330.

B. Flange gasket drilling pattern shall conform to ANSI B16.1/B16.5.

C. Flange gaskets shall be 1/8" thick.

D. Gasket material shall be EPDM.

2.12 Fasteners

A. Hex head bolts and nuts shall be stainless steel 316 conforming to ANSI/ASME B18.2.1 and ANSI/ASME B18.2.2.

2.13 Pipe Supports

A. All components of the bracket assembly shall be stainless steel 304 in accordance with the associated standards.

B. The bracket assemblies shall consist of four components:

1. A base plate (when required). For concrete tanks, the base plate will have four thru holes for expansion anchors.
2. A top-works weldment that consists of structural channel and angle iron. The TMS piping shall rest on the angle iron. The angle iron has predrilled holes for the U-bolt.
3. U-bolt with four hex nuts.
4. An 1/8" thick EPDM strip with a length equivalent to the circumference of the pipe. The strip shall be placed between the pipe and the angle iron and U-bolt.

C. The channel of the top-works weldment shall be field fit and modified to the required length. The channel shall then be field welded to the base plate.

D. For steel tanks, the base plate shall be field welded to the tank floor or shell. The location of the base plate shall avoid welded joints in the floor/shell plates.

E. For concrete tanks, the support shall be anchored to the concrete floor with stud type expansion anchors, the pull-out rating of the combined anchors shall be a minimum of 10 times greater than the static weight of the vertical pipe section.

F. Spare Parts: Spare parts are not required.

G. Quality Control and Quality Assurance: The HMS manufacturer shall have at least fifteen (15) years experience in the manufacturing of duckbill style elastomeric valves and shall have duckbill valves installed on manifold piping systems in at least 100 distribution system water storage tanks. The HMS manufacturer shall have conducted independent hydraulic testing to determine headloss and jet velocity characteristics on a minimum of eight (8) sizes of duckbill valves ranging from 2-inch to 48-inch. The testing shall have included multiple constructions (stiffness) within each size and shall have been conducted for free discharge (discharge to atmosphere) and submerged conditions. Independent hydraulic testing shall also have been conducted to prove repeatability of the manufacturing process to produce the same hydraulic characteristics.

PART III. EXECUTION

3.01 Installation: Installation of the manifold system shall be in accordance with the guidelines provided by the HMS manufacturer as specified in the installation section of the IOM manual. The manifold an duckbill valves shall be installed such as to allow a minimum of one (1) foot from the dry access tube in order to allow sufficient room for painting.

3.02 Leveling of Piping:

A. The centerline elevation of all distribution piping shall be installed at the same elevation across the entire system unless eccentric reducers are utilized, then the governing elevation point shall be the bottom invert of the pipes. Vertical piping shall be level and equidistant from the center tube throughout the installation.

B. The Contractor shall be responsible for providing a leveling instrument during installation of the piping for maintaining manifold pipe constant elevation as specified on the installation drawings.

C. The elevation variance shall not exceed +/-1" difference of the specified elevation on the installation drawings.

3.03 Start-Up and Testing Procedures: The HMS manufacturer shall provide one (1) day start-up services by a factory representative to verify that the system has been installed in accordance with the design specifications and requirements listed within this section and as recommended by the manufacturer.

3.04 Start-Up Flow Testing:

A. Following installation of the complete HMS, the system shall be tested. The Owner shall open the upstream altitude valve to allow flow into the tank through the manifold system. The altitude valve must be opened slowly to prevent surge or over-pressurization of the manifold system. The altitude valve must be fully opened to inspect the flow characteristics of the manifold system.

B. The Contractor shall visually inspect the entire piping system for leakage.

C. The Contractor shall visually inspect all the inlet nozzles to ensure flow is being discharged into the tank through all nozzles.

3.05 Warranty

A. The complete manifold piping system shall be supplied by the HMS manufacturer to maintain single source responsibility for the system. The complete system shall be defined as all piping and appurtenances within the tank downstream of the tank penetration. Appurtenances include pipe, fittings, horizontal and vertical pipe supports, expansion joints, duckbill valves, and any other equipment specified within this section of the specifications.

B. All piping, pipe support brackets, joint connections, expansion joints, and anchors shall be warranted by the HMS manufacturer against failure under design

conditions for a period on one (1) year from the date of final installation approval by the Engineer.

C. Inlet nozzles and outlet valves shall be warranted by the manufacturer against failure under design operating conditions for a period of one (1) year from the date of final installation approval by the Engineer. Elastomer components damaged as a result of maintenance activities, foreign debris, or excessive exposure to direct ultraviolet and thermal radiation shall be excluded warranted coverage.

END OF SECTION

SECTION 13210
COMPOSITE ELEVATED WATER STORAGE TANK

PART I. GENERAL

1.01 Summary

A Work Included

This section includes the design, construction, testing, and commissioning of a Composite Elevated Tank (CET) and related work including foundations, mechanical, and appurtenances.

B Related Documents

Drawings and the general provisions of this document, including General Conditions, Supplemental Conditions, Special Provisions and other Division 1 Sections apply to work in this section.

C Related Sections

1. Section 09900 Painting
2. Section 11268 Reservoir Hydrodynamic Mixing System (HMS)
3. Section 15110 Valves
4. Section 15140 Pipes and Pipe Fittings
5. Section 15430 Emergency Eye/Face Wash and Shower Equipment
6. Section 16000 Electrical

1.02 References

The latest version of the following Specifications, Codes and Standards are referenced in this section.

A.	ACI 117	Standard Tolerances for Concrete Construction and Materials
B.	ACI 301	Specifications for Structural Concrete Buildings
C.	ACI 304	Guide for Measuring, Mixing, Transporting and Placing Concrete
D.	ACI 305	Hot Weather Concreting
E.	ACI 306	Cold Weather Concreting
F.	ACI 318	Building Code Requirements for Structural Concrete
G.	ACI 347	Guide to Formwork for Concrete
H.	ACI 371	Guide for the Analysis, Design and Construction of Concrete Pedestal Water Towers
I.	AISC S335	Specification for Structural Steel Buildings
J.	ANSI B16.5	Pipe Flanges and Flanged Fittings
K.	ASCE 7	Minimum Design Loads for Buildings and Other Structures
L.	API 650	Welded Steel Tanks for Oil Storage
M.	ASTM A 123	Zinc Coatings on Iron and Steel Products
N.	ASTM A 240	Stainless Steel Plate, Sheet and Strip for Pressure Vessels
O.	ASTM A 285	Pressure Vessel Plates, Carbon Steel
P.	ASTM A 774	Welded Stainless Steel Fittings
Q.	ASTM A 778	Welded Stainless Steel Tubular Products
R.	AWWA D100	Welded Steel Tanks for Water Storage
S.	AWWA D102	Coating Steel Water Storage Tanks
T.	AWWA D107	Composite Elevated Tanks for Water Storage

U.	AWWA C652	Disinfection of Water Storage Facilities
V.	FAA 70/7460-1H	Obstruction Marking and Lighting
W.	NACE RP0178	Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service
X.	NFPA NEC	National Electric Code
Y.	NFPA 780	Standard for the Installation of Lightning Protection Systems
Z.	NSF 61	Standard for Drinking Water System Components
AA.	OSHA 29 CFR	Part 1926 Safety and Health Regulations for Construction
BB.	SSPC VIS-89	Visual Standard for Abrasive Blast Cleaned Steel

1.03 System Description

A. Elevated Tank

The Composite elevated tank shall consist of the following: foundation, reinforced concrete support structure and a welded steel water tank. The support structure shall extend vertically from the foundation as a circular concrete wall. A concrete slab shall be provided as structural support for the steel tank within the perimeter of the wall. A reinforced concrete ring beam shall be provided to connect the steel tank, concrete dome and concrete support wall. The elevated tank shall be in accordance with the shape, dimensions and details required by these specifications and drawings.

B. Operating Parameters

Minimum capacity within operating range		1,000,000	gallon
Maximum operating range		40	ft
Maximum fill rate		2000	gpm
Elevation	- overflow/top capacity level	1580	ft
	- grade slab	1458	ft
	- final ground	1457	ft
Support wall diameter		38 +/- 2	ft

C. General Design Standards

Structural design of the elevated storage tank shall conform to the following design standards except as modified by this section.

Foundations and Support Structure	ACI 318 and ASCE 7
Composite Tank	AWWA D107

D. Design Loads

Design loads shall be in accordance with ASCE 7 for Category IV (essential facility) structure.

1. Dead load shall be the estimated weight of all permanent construction.

2. Water load shall be the weight of water when the tank is filled to overflow.

3. Roof live load in addition to snow load: none.

4. Roof snow load shall be the larger of 15 psf. or the snow load determined in accordance with ASCE 7. Ground snow load shall be determined from Figure 7-1 in ASCE 7.

5. Wind loads shall be in accordance with ASCE 7 for wind exposure category C, and basic wind speed of 90 mph. (see Figure 6-1 in ASCE 7)

6. Horizontal and vertical seismic loads shall be in accordance with ASCE 7 and the Site Class as determined in the soil investigation report.

7. Importance factor I = 1.50.

8. Response Modification Coefficient R = 3.0 in accordance with ASCE 7

E. Combination of Loads

The effect of combination of loads shall be considered in accordance with the following.

1.4D + 1.6F + 1.6(L+S)
1.2D + 1.2F + L + 0.5S + 1.6W
1.2D + 1.2F + L + E
0.9D + 1.6W
0.9D + F + E

D	=	Effect of dead load.
F	=	Effect of water load.
E	=	Effect of horizontal and vertical seismic load.
L	=	Effect of interior or roof live load.
S	=	Effect of roof snow load.
W	=	Effect of wind load.

F. Foundation Design

The foundations shall be designed by the Contractor to safely support the structure based on the recommendations of the geotechnical report. Foundations shall be sized in accordance with AWWA D107, Section 7, "Foundations".

1.04 Submittals

A. Construction Drawings

1. Provide elevation, plan and sectional view drawings of the foundation, support structure, tank and all appurtenant equipment and accessories. Show the location, dimensions, material specifications, and finish requirements. The submission shall be sealed by professional engineer registered in the State of Missouri.

2. Foundation details shall include excavation, soil protection and backfill.

3. Reinforced concrete details shall include construction joints, openings and inserts. Reinforcement shall be clearly indicated on the structural drawings and identified by mark numbers that are used on the fabrication

schedule. Location, spacing and splice dimensions shall be shown. Placement and fabrication details shall conform to ACI 318.

Steel tank details shall include weld joints and a layout showing all primary and secondary shop and field welds.

B. Construction Procedures

1. Provide procedures for the support structure forming system. Procedures shall include form removal criteria and minimum elapsed time for adjacent concrete placement.

2. Provide shop and field weld procedures for all structural joints on the steel tank.

C. Design Data

1. Provide a table showing capacity of the tank in gallons at all levels in one foot increments.

2. Provide a summary of the design for the foundation, support structure, tank and other components. Include the design basis, loads and load combinations and results.

3. Provide a finite element analysis that accurately models the intersecting elements of the interface region. The interface region includes those portions of the concrete support structure and steel tank affected by the transfer of forces from the tank cone and the tank floor to the concrete support wall. The analysis shall provide results including the shear, moment, and compression or tension caused by the intersecting elements in the interface region.

D. Product Data

1. Provide a separate concrete mix design for each concrete compressive strength required or specified.

2. Provide technical data and color samples of all coating products.

3. Provide manufacturers descriptive information for appurtenant equipment and accessories that are not detailed on the construction drawings.

E. Reports/Certification

1. Provide documentation of all tests, inspections and certifications required by this section.

2. Provide qualifications of all welders.

1.05 Quality Assurance

A. Experience Requirements of Tank Contractor

1. The work described in this section shall be performed by a company that specializes in the design and construction of composite elevated tanks. The tank contractor shall have the following qualifications:

   a. A minimum of ten years of experience in composite tank design and construction.

   b. The design, construction and commissioning of a minimum five Composite elevated tanks of equal or greater capacity. These tanks shall be of the same design and constructed using forming systems as detailed by this specification.

B. Quality Assurance

1. Elevated tank design, concrete support structure construction and steel tank construction shall not be subcontracted. These items shall be self performed by the contractor.

2. The contractor shall directly employ a full time professional engineer with a minimum five years cumulative experience in the design and construction of Composite elevated tanks. The engineer shall be registered in the State of Missouri and shall be in responsible engineering charge of the work.

3. A qualified supervisor directly employed or subcontracted by the manufacturer shall be on site at all times during construction of the foundation, support structure and steel tank.

C Regulatory Requirements

1. The specifications, codes and standards referenced in paragraph 1.02 shall govern the work with regard to materials, design, construction, inspection and testing to the extent specified.

2. Personnel safety equipment shall be provided in accordance with OSHA requirements and manufacturers documentation.

1.06 Delivery, Storage & Handling

A Handling and Shipping

The Contractor shall handle materials and fabricated components in a manner that will protect them from damage. Allow painted materials adequate cure time prior to stacking or shipping.

B Storage and Protection

Protect delivered materials and equipment from damage. Store in well drained areas and provide blocking to minimize contact with the ground.

1.07 Project Conditions

A Permits and Easements

1. Permits, licenses, and easements required for permanent structures, changes in existing facilities or advancement of the construction as

specified shall be secured and paid for by the Owner prior to the start of construction. These include building permits, airspace authority approval, site access easements, highway crossing permits, etc.

2. Licenses or permits of a temporary nature required by specific trades shall be the responsibility of the Contractor.

B Existing Conditions

1. A geotechnical investigation has been carried out at the site and a report has been incorporated within these specifications in Appendix A. The net allowable bearing pressure of shallow foundations and/or the allowable capacity of deep foundation elements have been defined in this report. The Contractor shall be responsible for securing any further geotechnical information required beyond that provided in this report.

C Access

1. The Contractor shall provide access from public roads to the tank site as shown on the drawings.

D Working Conditions

1. Safety and Health - The Contractor shall comply with safe working practices and all health and safety regulations of OSHA, state and local health regulatory agencies and Material Safety Data Sheets (MSDS). Provide protective and lifesaving equipment for persons working at the site.

1.08 Sequencing and Scheduling

A Schedule

1. The Contractor shall provide a schedule indicating the design, submittals, site work and the major components of construction including foundation, support structure and steel tank. In addition, show tank painting, electrical installation and other significant activities. Update the schedule as required.

B Certifications

1. Provide certification from the engineer of record that the elevated tank has been designed in accordance with the requirements of the specification.

2. Provide certification that testing and inspection requirements of 3.07 have been performed and the results comply with the requirements of the specification.

PART II PRODUCTS

2.01 Materials

A Reinforced Concrete

1. Concrete materials and reinforcement shall comply with ACI 318, except as modified in this section.

B Steel Tank

1. Steel tank components, including steel plates, sheets, structural shapes and filler metals shall be in accordance with AWWA D107, Section 5, "Steel Tank".

2.02 Concrete Foundation

A. The concrete foundation shall be designed in accordance with ACI 318. Minimum specified compressive strength shall be 4000 psi at 28 days. The service load reinforcement tension stress shall not exceed 30,000 psi under dead plus water load unless flexural cracking is otherwise controlled in accordance with ACI 318.

2.03 Concrete Support Structure

The concrete support structure shall be designed in accordance with ACI 318. The specified compressive strength of concrete shall be as required by design, but not less than 4000 psi at 28 days. The maximum specified compressive strength of concrete for the wall and dome shall be 6000 and 5000 psi respectively.

A. Support Wall

Support wall shall be reinforced concrete with a minimum thickness of 8 inches exclusive of any architectural relief. Wall thickness shall be provided such that the average compressive stress due to the weight of the structure and stored water is limited to 25% of specified compressive strength, but not greater than 1000 psi. A minimum total wall reinforcement of 0.15% vertically and 0.20% horizontally shall be distributed approximately equally to each face. A minimum of 0.75% vertical reinforcement shall be provided in the top 6 ft. of the wall extending into the concrete ring beam. Minimum concrete cover for interior / exterior faces shall be 1 inch and 1-1/2 inches respectively.

B. Tank Floor

Tank floor shall be a reinforced concrete dome not less than 8 inches thick. The average compressive stress due to the weight of the structure and stored water shall not exceed 15% of the specified compressive strength, nor greater than 600 psi. Minimum total reinforcement in orthogonal directions shall be 0.40% distributed approximately equally to each face. Additional reinforcement shall be provided for stress caused by edge restraint effects.

C. Openings

The effects of openings in the wall shall be considered in the design. Not less than 60% of the interrupted reinforcement in each direction shall be placed each side of

the opening. Reinforcement shall extend past the opening not less than half the transverse opening dimension.

Openings wider than 3 ft. 6 in. shall be subjected to a rigorous analysis taking into account the stress concentrations and diminished lateral support that exist in the vicinity of such openings. Each side of the opening shall be designed as a column in accordance with ACI 318.

Openings 8 ft. 0 in. or wider used for vehicle access shall be strengthened against vehicle impact and local buckling by means of an internal buttress located on each side of the opening. The buttress shall consist of a thickened, reinforced concrete wall section that is integrally formed and placed with the support wall. The buttress section shall be not less than 3 ft. 0 in. wide and 6 in. thicker than the nominal wall dimension.

1. Pipe Bollards: Provide four (4) eight-inch diameter steel safety posts outside the opening to protect the door. Safety posts shall be filled with concrete and painted safety yellow. Bollards shall have a steel cap on the top and coated with a safety yellow coating.

2.04 Concrete Support Structure / Steel Tank Interface

The concrete dome tank floor and concrete to tank interface shall conform to the requirements of ACI 371R.

A Interface Region

1. The interface region includes those portions of the concrete support structure and steel tank affected by the transfer of forces from the tank cone and the tank floor to the concrete support wall. This includes a ring beam and connection details. The Contractor shall provide evidence that a thorough review of the interface region has been performed. Finite element and finite difference analyses are the required methods for examining such local stresses in detail.

2. Eccentricity arising from geometry and accidental imperfections in the construction process should be included in the analysis. Various stages of filling and wind and seismic overturning effects should be considered when determining the design loads.

3. The geometry of the interface shall provide for positive drainage and not allow either condensate or precipitation to accumulate at the top of the concrete wall or ring beam.

B Ring Beam

1. The ring beam shall be reinforced concrete with a nominal width and height of at least two times the support wall thickness. Minimum radial and circumferential reinforcement shall be 0.25%. For direct tension, reinforcement shall be provided such that the average service load stress in tension reinforcement due to the weight of the structure and stored water does not exceed 12,750 psi.

2. Ring beam design shall consider unbalanced forces from the steel tank cone and concrete dome, load conditions varying with water level,

eccentricity of loads resulting from design geometry, and allowance for variations due to construction imperfection and tolerance.

2.05 Welded Steel Tank

A General

The steel tank shall be all welded construction and shall be designed in accordance with AWWA D107, Section 5, “Steel Tank”. The required capacity and dimensions of the tank are noted on the drawings and in this section of the specifications. All exposed lap joints shall be fully seal welded on both sides.

B Plate Thickness

All members shall be designed to safely withstand the maximum stress to which they may be subjected during erection and operation. The minimum thickness of any steel plate shall be 1/4 in., except that plate used as a membrane over the structural concrete floor shall have a minimum thickness of 1/4 in.

C Roof Support

All structural members supporting the roof of the steel tank shall be flat bar or sealed square tubular sections. I-beams or other sections with horizontal projections may be used if the nominal depth is 10 in. or greater. Support beams shall be seal welded to the underside of the roof plate along the entire length of the beam.

D Cone

Conical sections of the tank that support water shall be designed in accordance with AWWA D107, Section 5, “Steel Tank”.

E. Tank Roof

The tank roof shall have a domed or steel roof to prevent ponding on the roof plates. All interior and exterior roof plate lap joints shall be sealed by continuous welding. Any roof support beams or rafters shall be seal welded along their entire length. Support beams shall be seal welded to the underside of the roof plate along the entire length of the beam.

2.06 Appurtenances and Accessories

A General

1. Accessories shall comply with the minimum requirements of the Specifications, Codes and Standards listed in 1.02, and the operating requirements of the structure.

B Ladder Access

1. Ladders shall be provided from the slab on grade inside the base of the support wall to the upper walkway platform located below the tank floor. The tank floor manhole shall be provided with ladder access from the upper platform. A ladder shall extend from the upper platform, through the access tube interior to the roof. A ladder mounted on the access tube

exterior shall be provided for access to the tank interior, extending from the roof manhole to the tank floor.

2. Ladders that terminate at platforms or landings shall extend a minimum of 48 in. above the platform elevations. A safety extension shall be provided at the top of the ladder under hatch(s). The safety extension shall be a Ladder Up Safety Post as manufactured by Bilco or equal. The post shall extend 42-inches above the top of the ladder and be constructed of hot dip galvanized steel. Mounting hardware shall be galvanized.

3. Ladders located in the concrete support structure and access tube interior shall be galvanized steel. Tank interior ladders shall be coated in accordance with the tank interior coating system.

4. Ladder side rails shall be a minimum 3/8 in. by 2 in. with a 16 in. clear spacing. Rungs shall be minimum 3/4 in. diameter, spaced at 12 in. centers and plug welded into holes drilled in the side rails. Tank interior ladders shall be provided with 1 in. diameter rungs and 1/2 in. x 2 in. side rails and shall be fully seal welded.

5. Ladder shall be secured to the adjacent structure by brackets located at intervals not exceeding 10 ft. Brackets shall be of sufficient length to provide a minimum distance of 7 in. from the center of rung to the nearest permanent object behind the ladder. Ladder brackets located on the access tube exterior shall be reinforced at the access tube shell so that potential ice damage is confined to the ladder and bracket and not the access tube shell.

6. All ladders, handrails, safety cages and other safety appurtenances shall conform to Federal OSHA Regulation 29 CFR Part 1910. Railings or handholds shall be provided where persons must transfer from the access tube to the water compartment.

C Safe Climbing Device

1. High strength aluminum, rigid rail safe climbing devices shall be provided on all ladders. Rails shall be center mounted and extend from 3 ft. above the ladder bottom to the top of the ladder section. Mounting brackets, fasteners and splice bars shall be provided as required for a rigid installation.

2. Three trolleys with snap hooks shall be provided that are designed to be operated with the aluminum rail. A safety body harness with front and side rings shall be supplied for each trolley.

3. A caution sign shall be provided at the lowest point of access to the ladder requiring safe climbing devices. The sign shall read “CAUTION – Safety Equipment Required When Climbing Ladder “. The sign shall be secured to the wall.

4. System shall be the Glide-Loc Ladder Climbing System as manufactured by Miller Fall Protection. Contractor shall provide two(2) safety harnesses, lanyards and Glide-Loc couplings.

D Rest Platforms

1. Rest platforms shall be provided at maximum 30 ft. intervals along the support wall ladder. Platforms shall be minimum 3 ft. by 5 ft and complete with handrails, mid rails and toe plates in accordance with OSHA requirements. Grating shall be used for the walking surface and shall be suitably hinged at the ladder penetration. Platforms shall be arranged for straight run ladder and operable without removing fall prevention equipment. All components shall be galvanized steel. A minimum 6-inch wide grated foot rest shall be provided on both sides of the platform opening.

E Platforms

1. A 4 ft. wide upper walkway platform shall be located at the top of the support wall to provide access from the support wall ladder to the roof access ladder located on the interior of the access tube. Platforms shall be provided with handrails, mid rails and toe plates in accordance with OSHA requirements. Grating shall be used for the walking surface. All components shall be galvanized steel.

F. Support Wall Doors

1. Personnel Door - Door frames shall be 16-gauge with concealed reinforcement at hardware locations. Expansion type anchors for existing openings shall be installed near the top, bottom and intermediate point of each jamb to rigidly secure the frame. Doors shall be 1 3/4 in. thick insulated, reinforced, full, flush type with 18-gauge face sheets and concealed reinforcement at hardware locations. All edges shall be finished flush with watertight seams. Shop applied finish for the frame and door shall be baked on rust inhibitive primer. Field finish shall be compatible with the tank exterior. Standard hardware shall be stainless steel and include three 4 1/2 in. by 4 1/2 in. hinges, industrial duty closer and lockset.

2. Quantity and location of personnel door(s) shall be as shown on the drawings.

3. Door and frames shall provide a tight seal to prevent entry of birds and insects.

G Tank Openings

1. Floor - Provide a 30 in. diameter manhole through the tank floor. The manhole shall be operable from a ladder located on the upper platform and shall be designed to withstand the pressure of the tank contents without leakage. The manhole assembly shall include a stainless steel hand wheel operator and threaded components.

2. Roof - Provide two 30 in. square or 30” diameter weather proof access hatches on the roof of the tank. One hatch shall allow egress from the access tube to the roof. The second hatch, located adjacent to the first,

shall allow access to the interior of the tank via the ladder mounted on the exterior of the access tube. The opening shall have a minimum 6 in. curb. Provide aluminum covers with a 2 in. down turned edge, stainless steel hardware, hold open arm and a locking mechanism. Hatches shall be provided with a gasket.

H. Access Tube

1. Provide a minimum 48 in. diameter centrally located access tube through the steel tank to provide access to the tank roof from the upper walkway platform. The access tube shall incorporate a 2 in. by 2 in. channel to collect condensation that may form on the interior surface. A flexible 3/4 in. PVC hose complete with backflow preventer shall drain the channel to the overflow pipe.

I. Roof Railing

1. A 42 in. high roof handrail shall be provided to enclose all centrally located roof accessories. The roof railing shall comply with OSHA requirements.

J. Rigging Access

1. Provide a 24 in. x 36 in. opening at the top of the support wall. This opening shall be accessible from a platform and shall provide access to the exterior rigging rail located at the tank/support wall intersection. The access opening shall be provided with a hinged stainless steel cover or a removable vent in accordance with 2.06.M.2.

2. A minimum 24 in. diameter opening shall be provided on the tank roof to provide access to the tank interior rigging rail.

K. Rigging Rails

1. Provide permanently installed rigging rails suitable for rolling trolleys at the interior of the tank at the wall/roof and access tube/roof connections. Provide an exterior rigging rail at the base of the tank adjacent to the support structure.

L. Piping

1. Inlet/Outlet Pipe - Provide a 16 inch diameter inlet/outlet pipe that extends from the base of the support structure to the tank floor elevation. The bottom capacity level of the tank's operating range shall be at or above the elevation of the top of the silt stop. Pipe material within the support structure shall be Schedule 10S Type 304L stainless steel. Piping below the grade slab shall be flanged cement lined ductile iron suitably restrained to prevent movement.

2. The inlet/outlet pipe shall be designed to support all related static and dynamic loads. Suitable galvanized steel brackets, guides and hangers shall be provided on the support wall and tank floor at intervals not exceeding 20 feet.

3. The inlet/outlet pipe shall be designed and constructed to accommodate any differential movement caused by settlement and by thermal expansion

and contraction over the range of extreme temperature differences expected for the support wall and pipe. The required flexibility shall be provided by an expansion joint located near grade in the vertical section of pipe. Inlet/outlet pipe shall be insulated to protect from freezing. Insulation shall meet the following requirements:

a. Insulation: 2" Thick Trymer 2000 XP Rigid Foam Polyisocyanurate insulation with vapor barrier
b. Moisture Barrier: 40 lb. Kraft paper with 1 1/2 mil polyethylene.
c. Jacketing: Aluminum, ASTM B209, 0.016 inch thick, smooth finish, type 3003. Pipe jacketing shall be RPR Products" Insul-Mate Jacketing" or approved equal.
d. Insulation Bands: Insul-mate "Z-lock jacketing".
e. Metal Jacket Bands: 3/8" wide by 0.020 aluminum.
f. Adhesives: Compatible with insulation.

4. Overflow Pipe - Provide a 16 inch diameter overflow. The top of the overflow shall be located within the tank at the overflow elevation. It shall run vertically beside the central access tube and extend through the tank floor, at which point it shall turn 90° and run under the tank floor to the support wall. This horizontal run shall be sloped to drain. The pipe shall then turn 90° and run vertically beside the support wall to grade. A base elbow shall direct the overflow through the support wall, where the pipe shall be terminated with a flap valve. Pipe material within the support structure shall be Type 304L (minimum 11 gauge) stainless steel. If the top of overflow is located above top capacity level, the tank shall be designed for the additional capacity provided by the difference.

5. The entrance to the overflow pipe shall be designed for the maximum inlet flow rate specified in 1.03B. The design shall be based on the water level cresting within 6 in. above the overflow elevation. A conical weir shall be provided if the entrance capacity of the overflow pipe diameter is not adequate. A vortex prevention device shall be used.

6. The overflow shall be designed to support all related static and dynamic loads. Suitable galvanized steel brackets, guides and hangers shall be provided on the support wall and tank floor at intervals not exceeding 20 ft. The overflow pipe and weir section within the tank shall be carbon steel and supported by the central access tube.

7. The overflow pipe shall be designed and constructed to accommodate any differential movement caused by settlement and by thermal expansion and contraction over the range of extreme temperature differences expected for the support wall and pipe. A layout with sufficient upper offset to accommodate differential movement is acceptable. If this method is not applicable, the required flexibility shall be provided by an expansion joint located near grade in the vertical section of pipe.

8. The overflow pipe shall penetrate the support wall approximately 1 ft. above grade and discharge through a flap valve onto a 5 ft. wide x 15 ft. concrete splash pad.

9. Stainless Steel Requirements - Pipe and fittings shall be Type 304L stainless steel fabricated from material meeting the requirements of ASTM A-240. Fabrication, inspection, testing, marking and certification of pipe and fittings shall be in accordance with ASTM A-778 and A-774 respectively. All fittings less than 18 inches shall be smooth flow, fittings larger than 18 inches may be of five section mitre construction. Backing flanges shall be in accordance with ASTM A285-C drilled to ANSI B16.5 Class 150. Pipe, fittings and welds shall be cleaned and passivated.

10. Pipe, fittings and flange thickness shall be in accordance with the manufacturers certified pressure rating for the applicable service pressures. The design pressure rating shall be minimum 125 psi for piping located within closed or valve sections.

11. Tank Drain – A tank drain shall be provided to completely drain the tank contents if the inlet/outlet pipe does not intersect the low point of the tank. A four inch drain pipe located at the low point of the tank floor shall be fitted with a threaded plug and tee handle.

M Ventilation

1. Tank Ventilation - A tank vent shall be provided, located centrally on the tank roof above the maximum weir crest elevation. It shall consist of stainless steel or aluminum components, including a support frame, screened area and cap. The screen material shall be 18 mesh stainless steel. The support shall be fastened to a flanged opening in the tank roof. The vent cap shall be provided with sufficient overhang to prevent the entrance of wind driven debris and precipitation. A minimum of 24 in. shall be provided between the roof surface and the vent cap.

2. The tank vent shall have an intake and relief capacity sized to prevent excessive pressure differential during the maximum flow rate of water, either entering or leaving the tank. The overflow pipe will not be considered as a vent. The maximum flow rate of water entering the tank is specified in 1.03B. The maximum flow rate of water exiting the tank shall be calculated assuming a break in the inlet/outlet at grade when the tank is full. The vent shall be provided with an insect screen. Vent capacity shall be determined based on open area provided by the screen.

3. In addition to the tank vent, a pressure/vacuum relief mechanism shall be provided that will operate in the event of vent failure. The mechanism shall be designed to return automatically to its original position after operation. The pressure/vacuum relief mechanism shall be located on the tank roof above the maximum weir crest elevation, and may be incorporated in the vent assembly.

4. Support Structure Ventilation - Ventilation within the support structure shall comply with the governing building code requirements, based on occupancy classification. As a minimum, one louvered vent shall be provided at the top of the support wall. This vent shall be accessible from the upper platform and may also be designed to provide access to the exterior rigging rails located at the tank/support wall intersection. Vents shall be accessible from the interior ladders, platforms or floors provided.

Vents shall be stainless steel or aluminum and provided with a removable insect screen.

N Interior Floors

1. Slab on Grade - Provide a 6 in. thick, 3500 psi concrete floor slab in the base of the support structure. The slab shall be supported on compacted granular fill and shall be reinforced with #4 reinforcing steel at 12 in. centers each way. Provide 1/2 in. expansion joint between floor slab and support wall and at pipes and supports that extend through the floor. Place cap strip and sealant over the expansion joint. The slab shall be sloped at 0.5% toward the personnel door for drainage.

O Level Monitoring

1. General - Provide three 1 in. corporation stops to the inlet/outlet pipe 5 ft. above grade. Each coupling shall be provided with a stainless steel nipple, an isolation valve, and a stainless steel tee.

2. Pressure Gauge - Provide a pressure gauge in accordance with ASME B40.1 Grade 2A. The dial shall be 4 1/2 in. diameter with black markings on white background. Pressure range is 0-100 psi.

P Lightning Protection

1. Provide a lightning protection system for the elevated tank structure and any roof mounted equipment that may be damaged by lightning.

2. Minimum requirements include two 28 strand by 14 gauge copper conductors bonded to the steel tank 180 degrees apart. The conductors shall be fastened to the interior support wall at 3 foot minimum spacing, and shall terminate with buried 5/8 inch diameter by 8 foot long copper clad ground rods.

Q Cathodic Protection Anode Supports

1. The contractor shall furnish and install only the attachments for a new year-round, ice-resistant, submerged cathodic protection system. Any entrance penetrations shall be cut and 3000# couplings shall be installed in the openings with continuous fillet welds on both the interior and exterior surfaces. The location of all attachments and fitting shall be in accordance with the Owner reviewed drawings from the accepted Cathodic Protection System contractor. New submerged anode support devices shall be welded by the Contractor to the interior of the tank prior to surface preparation. Brackets for the cathodic protection cabinet shall be furnished and installed by the Contractor in accordance with the Owner reviewed drawings prior to the painting of the tank. The welds shall be smooth. The Contractor shall obtain the anode brackets, bracket location drawing, and entrance couplings from the following:
   a. Freeman Industries, Inc., 3322 Mells Road, Dorset, OH 44032, Telephone (440) 858-2600, Fax (440) 858-2006.

b. Southern Cathodic Protection, 1100 Johnson Ferry Road, Suite 108, Atlanta, GA 30342, Telephone (404) 252-4649, Fax (404) 252-1824

2.07 Electrical and Lighting

Electrical work shall be in accordance with Division 16

2.08 Steel Tank Painting

Refer to Section 09900 for tank coatings. Galvanized, stainless steel and concrete surfaces are not coated.

2.09 Source Quality Control

1. Tests

Review mill test certifications of all steel plate, structural components and reinforcement to ensure compliance with specification requirements.

2. Inspections

Provide inspection of shop fabricated components in accordance with AWWA D107, Section 9, “Inspection and Testing”.

PART III. EXECUTION

3.01 Foundation

A Excavation

1. The foundation bearing surface and excavation shall be inspected by a representative of the geotechnical engineer prior to foundation construction. Verification of the applicable design and construction recommendations is required. The geotechnical engineer shall be retained by the Contractor. After verification of the foundation bearing surface, provide a 2 in. thick concrete working slab within the lower excavation limits. Grade the site to prevent runoff from entering the excavation.

B Concrete Construction

1. For shallow foundations, reinforcement placed adjacent to a concrete working slab shall have a 2 in. minimum cover, and shall be supported by precast concrete block, metal or plastic bar supports.

2. The sides of foundations shall be formed using any suitable system conforming to ACI 318. Earth cuts shall not be used as forms for vertical surfaces. Forms shall be provided on top sloping surfaces steeper than 2.5 horizontal to 1 vertical. Straight form panels may be used to form circular foundation shapes. The minimum design radius shall be maintained at all sections.

C Finish

1. Formed surfaces shall have a smooth form finish when exposed and a rough form finish when not exposed.

2. Unformed surfaces shall have a troweled finish when exposed and floated finish when not exposed.

3.02 Concrete Support Structure

A Architectural Concrete Construction

1. The exposed exterior surface of the concrete support wall is designated architectural concrete. Architectural concrete is required and shall be enforced. The concrete and formwork requirements of this section shall be strictly enforced to ensure concrete of the highest practicable architectural standard. Formwork design, installation and removal shall comply with the minimum requirements of ACI 318, ACI 117 and the applicable requirements of ACI 347, except as modified by this Section.

2. Attention shall be given to ensure the same concrete design mix is used throughout the support wall. The proportion, type and source of cement and aggregates shall not be changed. Uniform moisture content and placing consistency shall be maintained.

3. Placement is crucial to achieving architectural concrete. All wall concrete shall be placed vertically and directly inside the reinforcement cage with drop chutes to prevent form splatter and the resulting surface finish variations. Placement methods that introduce concrete horizontally through wall reinforcement are strictly prohibited.

4. Support wall reinforcement shall be installed with plastic supports. Maximum spacing of supports for welded wire fabric shall be 5 ft. centers, horizontal and vertically. Forming systems shall be designed with the provision of ties and bracing such that concrete components conform to the correct dimensions, shape, alignment and elevation. Embedded items shall be properly positioned and secured. Form surfaces shall be thoroughly cleaned of concrete residue and coated with a release agent prior to placing reinforcement. Do not allow excessive release agent to accumulate on the form surface. Steel forms shall be coated with a non-staining, rust preventative form oil or otherwise protected. Steel formwork with rust stains and damaged surfaces shall not be used.

5. Support wall concreting shall incorporate segmented placement procedures. Segmented placement procedure is required and will be enforced. Temporary vertical bulkheads shall divide the wall pour into segments corresponding to a single truckload of concrete. The bulkheads shall be located at rustications, braced rigid and tight to maintain vertical alignment under concrete load. Wall segment concrete shall be placed vertically and continuously to full form height from a single truck load of concrete. Vertical pour rate shall be a minimum of 15 feet per hour. Placement from multiple loads is not permitted. Temporary bulkheads shall not be removed until adjacent concrete is placed.

6. The forming system for the pedestal wall shall be fully engineered and detailed with procedures to meet the increased demands of architectural concrete. The support wall shall be constructed with a jump form process using form segments prefabricated to match the wall curvature. Concrete pour height shall be a minimum of 4 ft. and a maximum of 12 ft. Form panels shall be designed for lateral pressures associated with full height plastic concrete head and eccentric loads resulting from the segmented wall pour procedure.

7. Form panels shall extend the full height of the concrete pour using only vertical panel joints. Form system shall be designed to lap and be secured to the previous wall pour. The space between the form and the previous pour shall be sealed to prevent grout leakage. Wall forms shall incorporate a positive means of adjustment to maintain dimensional tolerances specified. Wall forms shall be adjusted for vertical plumb and circularity and locked into position with through wall form ties prior to concrete placement. Working platforms that allow safe access for inspection and concrete placement shall be provided. Form surfaces shall be steel, plastic or fiberglass coated material.

8. The form system shall incorporate a uniform pattern of vertical and horizontal rustications to provide architectural relief to the exterior wall surface. Rustication strips shall be sealed to the form face to eliminate the grout leakage that results in broken corners, color variations and rock pockets. Broken edges and chamfers will not be accepted. All construction joints and panel joints shall be located in rustications. Vertical panel joints shall be sealed using closures which combine with the form pattern to eliminate grout leakage and panel joint lines. All joints shall be grout tight. The vertical and horizontal rustications shall be proportioned and combined to impart a symmetrical architectural pattern to the completed structure. Form ties shall be located in a uniform pattern. No architectural form treatment is required on the interior surface.

9. Wall forms shall not be disturbed or removed until the concrete has attained sufficient strength to prevent forming operations or environmental loads from causing surface damage or excessive stress. Support wall concreting operations shall occur a maximum of once per day. Forms are to be removed and the concrete finish inspected prior to the subsequent placement of the next wall pour. Multiple form movements and concrete placements within a day are not permitted. Form removal shall be based on early age concrete strength testing. The minimum concrete strength shall be established by the Contractor, based on an analysis of stress at critical stages throughout the forming and concrete operations. Early age concrete testing shall be in accordance with ACI 228.1R-95. Pull Out testing in accordance with ASTM C 900-99, Maturity Method testing in accordance with ASTM C 1074-93, or field cured cylinders compressive strength tested in accordance with ASTM C 172 are the acceptable methods to determine early concrete strength.

10. In periods of cold weather as defined by ACI 306, concrete surfaces shall be protected in accordance with recommendations until the component attains 35% of the specified compressive strength. At this time, protection

may be removed subject to the allowable temperature differential. A reasonable temperature differential shall be defined, based on component thickness and restraint conditions.

B Finish

1. Provide a smooth form finish without rub for the interior and exterior support wall. Tie holes shall be plugged using grout on the interior and manufactured plugs on the exterior which match the color of the cured concrete as closely as possible. Provide a light sandblast to the exposed exterior concrete support wall surface.

C Dimensional Tolerances

Support structure concrete construction shall conform to the following:

Variation in thickness:
.....wall -3.0% to +5.0%
.....dome -6.0% to +10%
.....slab floor…….-3.0% to +5.0%
Support wall variation from plumb:
.....in any 10 feet of height 1 inch
.....in any 50 feet of height 2 inch
.....maximum in total height 3 inches
Support wall diameter variation 0.4%
.....not to exceed 3 inches
Dome floor radius variation 1.0%
Level alignment variation:
.....from specified elevation 1 inch
.....from horizontal plane 1/2 inch
Offset between adjacent pieces of formwork:
.....exterior exposed surfaces…. 1/8 inch
.....interior exposed surfaces….. 1/4 inch

D Mock Up Panel

1. A mock up panel shall be constructed using the proposed form surface and concrete. Minimum size will be 4 ft wide by 6 ft high. This panel shall be agreed upon by the Contractor and Engineer as the reference standard with which to judge surface quality, appearance and uniformity of texture and color for each individual lift.

2. Review and acceptance of formed concrete surface must be made immediately upon form removal. Succeeding pours shall not be placed until the most recent wall pour has been stripped and the form surface approved. The Engineer shall not delay the Contractor by lack of attendance. The Contractor shall be responsible to inform the Engineer as to pour schedule.

3. Concrete with surface defects exceeding limitations specified herein or not meeting the standard represented by the mock-up panel shall be repaired to meet that standard.

3.03 Steel Tank

A Welding

1. Welding procedures and general welding requirements shall be in accordance with AWWA D107, Section 9.5, "Welding".

2. No structural welding is permitted to any steel embedded in hardened concrete, unless the weld is at least 2 ft. from the embedment interface.

3. Grinding of weld contour shall approximate Condition "D" of NACE Standard RP0178.

B Fabrication

1. Layout, cutting, forming, edge preparation and workmanship for steel tank components and fabrications shall be in accordance with AWWA D107, Section 5.4, "Fabrication and Construction Requirements".

C Tank Erection

1. Steel tank erection procedures and general requirements shall be in accordance with AWWA D107, Section 5.4, "Fabrication and Construction Requirements".

D Tolerances

1. Steel tank tolerances shall be in accordance with the requirements of API 650, Section 5.5.

2. Steel cone shall be constructed to the following tolerance. The deviation from the theoretical conical surface shall not exceed 0.032 $\sqrt{RT}$, when measured in the radial direction over length $4\sqrt{RT}$, where R is the radius normal to the plate surface at the point of consideration, and T is the plate thickness.

3.04 Field Quality Control

A Concrete Testing and Inspection

1. The evaluation and acceptance of concrete shall be in accordance with the following:
   a. Furnish and install concrete to the depths, lines and dimensions shown on the contract drawings
   b. The source and quality of concrete materials and the concrete portions proposed for the work will be submitted to the Resident Engineer for review two (2) weeks before concrete is placed.
   c. The Resident engineer may take samples (4 cylinders per sample) of the concrete placed at the job.
   d. A sample may be taken for each 100 cy or fraction thereof and at least one sample per 8-hour shift. Sampling will conform to ASTM C172,

and preparation and handling of specimens will conform to ASTM C31.

e. Cylinders will be cured in the laboratory and tested by methods outlined in ASTM C39. Field curing may be required when air temperatures below 400F are anticipated.
f. The standard age of cylinders when tested will be 28 days, but 7-day tests may be used on written approval, when the strength relationship between 7-day and 28-day tests has been established for a specific mix. The strength of each set will be reported.
g. Should the tests of samples show a 28-day compressive strength less than the minimum set forth in Paragraph 1.03, A, work will be suspended and the remaining samples tested without delay.
h. Should these samples fail to meet specification requirements, all concrete work will be rejected and the Contractor will, at the Resident Engineer's option, remove all rejected concrete and replace it with concrete complying with specification requirements.
i. A slump test will be taken and the results recorded for each sample of concrete. The slump will be determined in accordance with ASTM C143.
j. For each sample of concrete taken, the entrained air content will be determined immediately after discharge from the mixer and in accordance with ASTM C231.
k. For each sample of concrete taken, the temperature will be taken and recorded according to ASTM C1064.
l. The cost of testing will be borne by City Utilities. Retests after an initial failed test will be paid for by the Contractor.

2. The support wall radius, plumb and thickness shall be verified for each concrete lift at all vertical form panel joints and at a minimum of 60 degree intervals. Vertical alignment and radius shall be checked using a visible beam laser. Measurement shall be made to the outside form surface. A log of the measurements and an inspection report certified by the tank designer shall be provided to the Owner at project completion.

B Steel Tank Testing & Inspection

1. Inspection procedures for the steel tank shall be in accordance with AWWA D107, Section 9, "Inspection and Testing". Radiographic inspection of full penetration butt-welded joints shall be made by an independent inspection company retained by the Contractor.

2. Erection tolerance of the steel cone in the radial direction shall be measured. Provide field measurements at 30 degree intervals.

3. Weld joints of plate over the structural concrete floor shall be tested for leaks by vacuum box / soap solution testing, or equivalent method prior to grouting.

3.05 Cleaning

A Site

1. The project site shall be kept in a clean and safe condition at all times. The Contractor shall remove all construction equipment and debris at project completion.

B Tank Disinfection

1. After curing and prior to disinfecting, the Contractor shall wash the tank interior with potable water. All equipment including brooms, brushes, spray equipment, and worker's boots shall be disinfected before they are used to clean the water storage facility. Thoroughly wash with sufficient pressure and flow all the interior surfaces, including those surfaces above the top capacity level. Water will be provided by the owner from the 16 inch main on the site. All residue shall be removed from the tank and shall be disposed of properly.

2. It is the Contractor's responsibility to flush and disinfect the tank until two consecutive satisfactory water samples are reported from the Owner's laboratory. Method 3 (Section 4.3.3) or Method 2 (Section 4.3.2) of AWWA C652-02 shall be used. The Owner shall take and send samples to the laboratory, but shall assume no responsibility for the sampling technique or the care of the samples. The stored tank samples shall comply with current state and US EPA standards for organic, inorganic, and biological contaminants as influenced by the operations of the Contractor.

3. Tank leakage test shall be performed during disinfection.

END OF SECTION

SECTION 15110
VALVES AND HYDRANTS

PART I. GENERAL

1.01 Work Included: Provide and install all valves as shown on the drawings and as specified herein.

PART II. MATERIALS

Butterfly Valve

2.01 Design and Construction: The butterfly valves shall conform to the requirements of ANSI/AWWA C504, Class 150B and NSF Standard 61 and shall by certified by NSF for use in drinking water.

A. Valve Body. Cast Iron ASTM A-126 Class B. Flanged valves shall be fully faced and drilled in accordance with ANSI Standard B 16.1, Class 125.

B. Valve Disc. The disc shall be a lens-shaped design to afford minimal pressure drop and line turbulence.

1. Materials of construction shall be: 8"-20" — ASTM A126, Class B cast iron disc with a stainless steel type 316 edge.

2. Discs shall be retained by stainless steel pins which extend through the full diameter of the shaft to withstand the specified line pressure up to valve rating and the torque required to operate the valve. Disc stops located in the flow stream are not allowed.

C. Valve Shaft. Valve shafts shall be of stainless steel type 304. At the operator end of the valve shaft, a packing gland utilizing “V” type chevron packing shall be utilized. “O” ring and/or “u” cup packing is not allowed.

D. Valve Seats. Rubber body seats shall be of one piece construction, simultaneously molded and bonded into a recessed cavity in the valve body. Seats may not be located on the disc or be retained by segments and/or screws. For wafer style valves, the seat shall cover the entire inner surface of the valve body and extend over the outside face of the valve body to form a flange gasket.

E. Valve Bearings. Valve bearings shall be of a self-lubricating, nonmetallic material to effectively isolate the disc-shaft assembly from the valve body. Metal-to-metal thrust bearings in the flow stream are not allowed.

F. Painting. All surfaces of the valve interior shall be clean, dry and free from grease before painting. The valve interior and exterior, except for disc edge, rubber seat and finished portions shall be evenly coated with an NSF61 approved 2-part liquid epoxy. Minimum dry film thickness shall be 4-6 Mils.

G. Testing. Hydrostatic and seat leakage tests shall be conducted in strict accordance with AWWA Standard C504.

H. Proof of Design. The manufacturer furnishing valves under the specification shall be prepared to provide Proof of Design Test reports to illustrate that the valves supplied meet the design requirements of AWWA C504.

I. Opening Direction. Valves inside the tank pedestal shall be open left.

J. Acceptable Manufacturers. Valves shall be manufactured by Pratt or Dezurik.

2.02 Electric Valve Actuator

Supply one Limitorque model QX electric valve actuator for the 16-inch butterfly valve in the tank pedestal.

A. Control compartment shall be the minimum integral compartment.

B. Power supply single phase, 60 HZ, 208/240 V.

C. Unit shall have flip-flop indication.

D. Unit shall have continuous position indication.

E. Unit shall have local/remote indication.

F. Unit shall have an R/I converter.

G. Unit shall have relay boards.

H. Unit shall have a side-mounted handwheel.

I. Unit shall have a double-pole toque switch.

Gate Valves

2.03 Design and Construction: The gate valves shall conform to the requirements of ANSI/AWWA C509, Latest Revision. Valves shall be certified by NSF for use in drinking water.

2.04 General: Valves shall be either non-rising stem or rising stem, opening by turning stem left or right and provided with 2" square operating nut or handwheel with the word 'open' and an arrow cast in the metal to indicate direction to open. The wedge shall be of ductile iron completely encapsulated with rubber. The sealing rubber shall be permanently bonded to the cast iron wedge to meet ASTM tests for rubber metal bond

ASTM D249. Valves shall be supplied with O-ring seals at all pressure retaining joints. No flat gaskets allowed. Stems for NRS assemblies shall be cast bronze with integral collars in full compliance with AWWA. OS&Y stems shall be bronze. The NRS stem stuffing box shall be the O-ring seal type with two O-rings located above thrust collar and one O-ring below. The two O-rings above the thrust collar shall be replaceable with valve fully open and subjected to full rated working pressure. There shall be two low torque thrust bearings located above and below the thrust collar. The stem nut shall be independent of the wedge and shall be made of solid bronze. There shall be a smooth, unobstructed waterway free of all pockets, cavities and depressions in the seat area. All internal parts shall be accessible without removing the body from the line.

2.05 Coating: The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior, complying with AWWA C-550 and be NSF 61 approved.

2.06 Marking: Each valve shall have maker's name, pressure rating and year in which manufactured cast on the body. Prior to shipment from the factory, each valve shall be

tested by hydrostatic pressure equal to AWWA (twice the specified working pressure) requirements.

2.07 Opening Direction. Buried valves shall be open-right and valves inside the tank pedestal shall be open-left.

2.08 Acceptable Manufacturers: American Flow Control, AVK, Clow, Kennedy, Mueller, or approved equal.

Fire Hydrants

2.09 Fire hydrants shall conform to AWWA C502, latest revision, certified by NSF for drinking water and modified as follows:

2.10 Main valve shall close with the water pressure. Hydrants shall contain frangible sections near the ground line designed to break on impact (breakaway or traffic type design). Design or frangible section shall permit facing of upper barrel by infinite degree and shall not rely on weakened bolts. Main valve assembly removal shall be accomplished from the top of the upper barrel by means of a short lightweight seat removal wrench utilizing the hydrant stem. The main valve seat ring shall be bronze and shall be threaded into a bronze drain ring. The main valve opening shall be 4-1/2" diameter. Provide two 2-1/2" connections and one 4-1/2" pumper connection all with threads in conformance with NFPA No. 194 for National Standard Fire Hose Coupling Screw Threads. Outlet nozzles shall be fastened to barrel by mechanical means, chains or cables on nozzle caps are to be omitted. Direction of opening shall be right (Clockwise). Operating nut and nozzle cap nuts shall be pentagon shaped, measuring 1-5/8" point to flat. A weather shield shall be provided to protect the opening between the wrench nut and the bonnet. A drain valve mechanism shall be provided as an integral part of the main valve assembly and shall consist of not less than two openings in the main valve seat ring and two external discharges. The upper valve plate shall be constructed of bronze and shall incorporate drain valve seals. Furnish o-ring seals on the valve stem to provide a dry head type operation. Steel valve stems shall have bronze sleeves in the o-ring areas. The prime coat from the ground line up shall conform to federal spec TT-P-636 only. Federal spec TT-P-86 is not acceptable . Coatings which contain more than 0.06% by weight of lead shall not be used. The hydrants shall be given a second coat of paint from the ground line up. Paint shall be safety yellow in color and shall be equivalent to Sherwin Williams industrial enamel B54 Series. Optional coating may be Valspar KPE84212P60 safety yellow. The coating shall contain reflective beads on the hydrant bonnet and all nozzle caps. The operating nut thrust collar shall be provided with an anti-friction washer of Teflon, delrin, Teflon coated material, or other anti-friction material approved by City Utilities. The base of the hydrant shall have a side inlet provided with a 6-inch mechanical joint end per ANSI/AWWA C111/A21.11.

Approved fire hydrants are: American Darling, Mark 73 (Springfield Special), Clow Medallion, Kennedy K81, Mueller Centurion Traffic Model A-421.

PART III. EXECUTION

3.01 BURIED VALVE AND FITTING INSTALLATION

A. Valves and Fittings

Set and join valves, fittings, plugs and caps to pipe in accordance with the manufacturer's recommendation. Where the top of a valve operating nut will be greater than four feet below finished grade, provide a suitable extension shaft to bring the operating nut to within four feet of grade and firmly attach to the valve. Hold the operating nut on the extension shaft of the valve box. Buried valves shall be open right. Correct setting and installation will be verified by operation of the valves and approved by the Resident Engineer.

B. Valve Boxes

Do not transmit shock or stress from the valve box to the valve. Center and plumb valve box over the operating nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed by the Resident Engineer.

C. Anchorage for Plugs, Caps, Tees and Bends

Provide all plugs, caps, tees and bends deflecting 11-1/4° or more on pipe two inches in diameter or larger with thrust blocks or other suitable thrust restraint in accordance with Water Standard WS-400, or as directed by the Resident Engineer.

END OF SECTION

SECTION 15140
PIPES AND PIPE FITTINGS

PART I. GENERAL

1.01 SECTION INCLUDES

A. Ductile iron pipe, joints, fittings, gaskets, and pipe linings and coatings.

1. RELATED WORK DESCRIBED ELSEWHERE:

a. Work by Others, Section 01110.

b. Field Engineering, Section 01720.

c. Demolition and Clearing, Section 02220.

d. Excavation and Backfilling, Section 02315.

e. Disinfection and Testing, Section 02515.

2. References

a. American Society of Mechanical Engineers (ASME):

1) B16.1 – Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

b. American Water Works Association (AWWA):

1) C104 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

2) C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.

3) C110 – Standard for Ductile-Iron and Gray-Iron Fittings.

4) C111 – Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

5) C115 – Flanged Ductile Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

6) C150 – Standard for Thickness Design of Ductile-Iron Pipe.

7) C151 – Standard for Ductile-Iron Pipe, Centrifugally Cast.

8) C153 – Standard for Ductile-Iron Compact Fittings for Water Service.

9) C600 – Installation of Ductile Iron Water Mains and Their Appurtenances.

10) C606 – Standard for Grooved and Shouldered Joints.

c. American Welding Society (AWS):

3. D11.2 – Guide for Welding Iron Castings.

B. ASTM International (ASTM):

1. A 47 – Standard Specifications for Ferritic Malleable Iron Castings.

2. A 183 – Standard Specifications for Carbon Steel Track Bolts and Nuts.

3. A 536 – Standard Specifications for Ductile Iron Castings.

4. A 536 – Standard Specifications for Ductile Iron Castings.

5. C 283 – Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.

6. D 792 – Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

C. Ductile Iron Pipe Research Association (DIPRA):

1. Thrust Restraint Design Manual.

D. NACE International (NACE):

1. SP0188 – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.

E. National Association of Pipe Fabricators, Inc. (NAPF):

1. 500-03 – Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings.

F. Society for Protective Coatings (SSPC):

1. PA-2 – Measurement of Dry Coating Thickness with Magnetic Gages.

1.02 SUBMITTALS

A. Product data: Photographs, drawings, and descriptions of fittings, gaskets, couplings, grooving of pipe and fittings, pipe linings, and coatings.

B. Shop Drawings:

1. Detailed layout drawings showing alignment of pipes, location of valves, fittings, and appurtenances, types of joints, connections to structures, and thrust restraint system layouts.

2. Thrust restraint systems: Calculations and layout for restrained joint thrust restraint systems.

C. Test reports:

1. Submit Coating Manufacturer’s Technical Representative’s reports.

2.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Block piping and associated fittings for shipment to prevent damage to coatings and linings.

B. Carefully handle piping and associated fittings during loading, unloading, and installation.

1. Do not drop piping material from cars or trucks.

2. Lower piping by mechanical means.

3. Do not drop or pound pipe to fit grade.

4. Pipe must be secured so that it cannot fall while being handled. Conventional chains, chain hooks and non-padded forklifts are expressly forbidden.

5. No forks, chains, straps, hooks, or other lifting device shall be placed inside the pipe or fittings for lifting, positioning, or laying.

C. Repair damaged cement mortar lining to match quality, thickness, and bonding of original lining in accordance with AWWA C104. When lining cannot be repaired or repairs are defective, replace defective piping with undamaged piping.

D. Protect gaskets from long-term exposure to sunlight.

E. Store piping, fittings, and other accessories such that they do not accumulate and hold rainwater, dirt, and debris.

F. In the event of damage, Contractor shall immediately make all repairs and replacements to the approval of the Inspector.

PART II. MATERIALS AND EQUIPMENT

1.04 DUCTILE IRON PIPE

A. General: Conform to the following, as applicable:

1. AWWA/ANSI C115/A21.15

2. AWWA/ANSI C150/A21.50

3. AWWA/ANSI C151/A21.51

4. Pressure Class 250

B. Fittings and Flanges: Conform to the following, as applicable:

1. AWWA/ANSI C110/A21.10

2. AWWA/ANSI C115/A21.15

3. AWWA/ANSI C153/A21.53

C. Joints:

1. Push-On Joints

a. American Pipe: Fastite

b. U.S. Pipe: Tyton

2. Mechanical Joints

a. ANSI/AWWA C110/A21.10

b. ANSI/AWWA C111/A21.11

3. Restrained Joints:

a. American Pipe:

1) Fastite – 4” to 24”

2) Flex-Ring – 4” to 54”

3) Lok-Ring – 54”

b. U.S. Pipe

1) Field LOK 350 – 4” to 24”

2) HP-Lok – 30” to 54”

4. Restrained Mechanical Joints:

a. Conform to AWWA C111.

b. All restrained mechanical joints shall be Series 1100 Megalug, no equal.

D. Fittings:

1. Ductile iron in accordance with AWWA C110 or AWWA C153.

2. Joint type: Restrained or Restrained MJ as shown on drawings meeting joint requirements of pipe

E. Lining:

1. Cement-mortar lining:

a. In accordance with AWWA C104, apply cement-mortar on clean bare metal surfaces. Extend to faces of flanges, ends of spigots, and shoulders of hubs.

b. Minimum lining thickness: Standard in accordance with AWWA C104.

c. Type of cement: Type II.

F. Coating

1. Asphaltic seal coat: Apply to outside surface of pipes that will not receive another coating. Apply in accordance with AWWA C151.

PART III. EXECUTION

3.01 INSTALLATION – GENERAL

A. Install pipe in strict accordance with the manufacturers' installation instructions and laying schedules. Run true to grade and alignment as shown on the drawings with fittings and valves at the required locations. Match and make connections to existing fittings at the points of termination of the piping system. Make tie-ins onto existing live water mains under the supervision of the Inspector using approved equipment and materials. Do not operate any valves, blowoffs or similar equipment on the existing water system of City Utilities without prior approval by the Inspector.

B. Install ductile iron piping in accordance with AWWA C600.

C. Install to the line and grade on the Drawings.

D. Laying condition: Type 5 in accordance with AWWA C150 as modified here. Where not encased in concrete, pipe shall have a minimum of 12" gravel bedding and 12" gravel on sides and top of pipe.

3.02 INSTALLATION METHODS

A. Install pipe by trenching as specified in Technical Specifications, Section 02315.

3.03 EXISTING UTILITIES

A. Contractor to verify the location of all underground utilities.

B. Omission from, or the inclusion of utility locations on the drawings is not to be considered as the nonexistence of or a definite location of existing underground utilities.

C. A representative of the underground utilities shall be notified in accordance with Missouri One-Call requirements.

D. Adjust water line elevation as required during construction. No separate payment will be made for field verification or adjustment of main depths as required.

E. Contractor will restore all existing structures or services damaged by Contractor's operations at no cost to Owner.

3.04 CONNECTION TO EXISTING FACILITIES

A. Coordinate service interruptions in accordance with Section 01140.

B. Prepare for connection to existing draw/fill line so as to minimize the amount of time the line is out of service.

3.05 PIPE CLEANING AND PREPARATION

A. Thoroughly clean and inspect all pipe and fittings for damage before placing in the trench. If damage to pipe is found during inspection, repair or replace the pipe as directed by the Inspector.

B. Prevent foreign material from entering the pipe while it is being installed. Allow no debris, tools, clothing or other materials in the pipe.

C. When pipe laying is not in progress for an extended period of time such as nights and weekends, close the open ends of pipe with a water tight plug. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry. Chlorine tablets may be added to the ditch water per AWWA C651 to avoid additional contamination as further described in section 2515. Do not use hypochlorite intended for use in swimming pools. Do not lay pipe in water or when trench conditions are unsuitable.

D. At close of day's work or whenever workmen are absent from jobsite, plug, cap or otherwise provide watertight seal from open ends of pipe to prevent ingress of foreign material.

E. If water is in trench, seal shall remain in place until trench is pumped dry.

3.06 REPAIR OF COATING

A. In case of damage to the protective coating or lining of ductile iron pipe, repair the pipe in accordance with AWWA C104. Repair of coating damage to epoxy coated surfaces shall be made with petrolatum wax tape.

3.07 PIPE SUPPORT AND EMBEDMENT

A. Support the barrel of the pipe by the granular leveling course with bell holes excavated for the bell end. Having so supported the pipe, embed it with granular material after joining pipe.

3.08 JOINING PIPE

A. Push-on Joints – In accordance with manufacturers recommendations, lay pipe with bell ends facing in the direction of laying unless directed otherwise by the Inspector. After placing a length of pipe in the trench, clean and lubricate the gasket and gasket groove. Center the spigot end in the bell. Force pipe home giving care to not over-bell the pipe, and bring to correct line and grade. Prevent dirt from entering the joint space.

B. Threaded Joints - Pipe dope or thread tape shall be applied to the threads prior to joining. threaded joints are only to be used on 2” and smaller water lines.

C. Compression (Pack or Mechanical) Joints - Install and tighten compression fittings per manufacturer’s instructions.

D. Flange joints - assemble joints above ground and lower into trench, unless otherwise acceptable to the Inspector. Tighten bolts per manufacturer's instructions.

E. Solvent Cement Joints - Shall not be used unless indicated on the design drawings.

F. Restrained Joints - Install per manufacturer's instructions and as detailed on the drawings.

3.09 PERMISSIBLE DEFLECTION AT JOINTS

A. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or plumb valve stems, or where long-radius curves are permitted, deflect in accordance with the manufacturer's recommendations and construction standards for satisfactory joining.

3.10 TIE-IN POINTS AND CROSSINGS

A. Expose existing casings, mains, storm drains, other utilities, and other obstacles well in advance of trenching and pipe laying to avoid abrupt changes in vertical alignment and the use of unnecessary fittings at tie-in points and crossings.

3.11 CUTTING OF PIPE

A. Cut pipe for inserting valves, fittings or closure pieces without damage to the pipe or cement lining and leave a smooth end at right angles to the axis of the pipe. Make all cuts in accordance with the manufacturer's instructions. Only cut 16" or larger ductile iron pipe after it has been gauged to determine if the diameter of the pipe is within tolerance at the proposed cut location.

3.12 VALVE AND FITTING INSTALLATION

A. Valves and Fittings - Set and join valves, fittings, plugs and caps to pipe in accordance with the manufacturer's recommendation. Valves shall be installed so operating nut is plumb so valve key will easily operate the valve within the box. Valve extension shafts shall not be used unless called for specifically on the design drawings. Valves shall be installed so that the operating nut is no more than eight feet below finished grade unless approved by the Inspector.

B. Valve Boxes - Install the valve box as to not transfer surface loads directly onto the valve. Center and plumb valve box over the operating nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed by the Inspector.

C. Anchorage for Valves and Fittings - All fittings shall have suitable thrust protection as indicated on the design drawing or in the construction standards.

3.13 LOCATOR WIRE & WARNING TAPE

A. Install #10 AWG LDPE solid copper locator wire blue in color on all trenched water piping. Install #12 AWG LDPE steel/copper clad blue locate wire on all tunneled water piping.

B. Install tracer wire per City Utilities Construction Standards.

C. Secure tracer wire to main by tape every 20 feet. Connect wire to existing locator wire where present. Do not connect wire to any existing metal mains. Connect wire utilizing approved epoxy filled connectors.

D. At ends of main, bring tracer wire to surface using a valve box per construction standards. Bring wire up for locating purposes at all meter pits, fire hydrants and valve installations per applicable construction standards.

E. Warning tape shall be installed with all water mains and services that are installed by trenching per applicable construction standards.

F. Install blue warning tape 6 inches above top of pipe within gravel fill, except where encased in concrete.

3.14 TESTING

A. Preventative Measures During Construction

1. During construction, the interior as well as all sealing surfaces of pipe, fittings, and other accessories should be kept as clean as possible. Inspect the interior of all pipes prior to installation. If dirt enters the pipe, it shall be removed.

2. All openings in pipelines should be closed with watertight plugs whenever the trench is unattended.

3. Sealing, lubricating, or gasket materials used in pipe installation shall be stored and handled in a manner that avoids contamination and be suitable for use with potable water.

B. Preliminary Flushing of Mains

1. Before pressure testing, the main should be completely filled with water from the low point to the high point when possible, to eliminate air pockets and then flushed to purge the line of dirt and debris.

2. The initial fill should be done slowly in order to eliminate all air pockets. The flow rate should not exceed 1 ft/s. All air relief valves, hydrants, and other access points should be opened during initial fill in order to ensure all air has been expelled. The initial fill shall be performed by the contractor.

3. If elected to be performed by OWNER, Preliminary flushing should follow the initial slow fill and should be done to achieve a flow rate of at least 2.5 ft/sec to scour the main and remove all foreign material.

Preliminary flushing shall be performed by CU Water Operations. Times shall be recorded for calculation of the amount of water used.

C. The following table shows the required flow rate to obtain a velocity of 2.5 ft/sec in commonly used sizes of pipe.

Flow Rates for Filling & Flushing

Pipe Size (inches)	1.0 ft/s Fill Velocity Flowrate (gpm)	2.5ft/s Flushing Velocity Flowrate (gpm)
16	627	1567

D. Hydrostatic Testing

1. The purpose of the hydrostatic test is both to test for the ability of the pipeline to withstand the applied pressure and to test for leakage.

2. Pipe Material Criteria: Ductile Iron AWWA C600 & Manual M41

3. Pressure testing shall not begin until all concrete thrust blocks, collars and restraint have cured to achieve the desired compressive strength. After the pipe has been laid, the main shall be filled slowly from the low point to the high point when possible and all air purged from the line through available hydrants, blow offs, and air relief valves. Once all air has been removed close air reliefs and other valves. The maximum length of piping to be tested at once shall be 2500 feet unless approved by Resident Engineer.

4. The main shall be tested at the test pressure indicated in the drawings as measured at the highest elevation of the water main under test or corrected for the elevation of the test gauge if not at the high point. A calibrated liquid filled gauge shall be used that has increments of 2 psi or less.

5. If extreme terrain differences are encountered on the project the piping pressure test shall be done in segments to ensure that no segment is pressure tested more than 1.5 times the systems design pressure rating.

6. Procedure for PVC and DI Water Mains:

   a. Gradually pressurize the test section to the test pressure at the highest point of the test section and maintain that pressure for two (2) hours or for the duration called for by the Resident Engineer. Add and measure make-up water as required to maintain test pressure. Clean potable water from an uncontaminated container shall be used for make-up water. Monitor and record the amount of make-up water utilized and document on the as-built drawing. Ensure that the amount of makeup water used to maintain the test pressure does not exceed

the maximum allowable leakage in the applicable AWWA standards or as calculated for each pipe size in the test section based on length.

7. Maximum Allowable makeup water (gal/hr) = (length)*(diameter)* √(test pressure) 148,000

8. If the test indicates leakage greater than the maximum allowable rate, locate and repair the defect. Run tests again after correction is made until leakage is within the allowable rate. Furnish all necessary labor and equipment for testing.

9. Contractor shall repair all visible leaks regardless of test results.

E. Repair damaged cement mortar lining to match quality, thickness, and bonding of original lining in accordance with AWWA C104.

1. When lining cannot be repaired or repairs are defective, replace defective piping with undamaged piping.

F. Tracer Wire Testing

1. Test tracer wire to verify a continuous signal on the wire. Contractor shall dig up and repair tracer wire where the signal isn't continuous.

3.15 CONTINUITY OF SERVICE

A. Prior to closing any valves, notify all affected customers 24 hours in advance and state how long the service will be curtailed. Cause no customer to be without service for more than eight hours. Schedule all tie-ins and other operations affecting customer service only as approved by the Resident Engineer. Carefully plan such operations in advance, verify materials and conditions, and work continuously until all customers are in service. Some off-hour work and overtime labor may be required to avoid causing unnecessary hardship for business, schools, etc. Contractor shall bid accordingly.

END OF SECTION

SECTION 15430
EMERGENCY EYE/FACE WASH AND SHOWER EQUIPMENT

PART I. GENERAL

1.01 SUMMARY

A. Section includes: Emergency shower and eyewash.

B. Related section:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

1.02 REFERENCES

A. American National Standards Institute (ANSI):

1. Z358.1 – Emergency Eyewash and Shower Equipment.

2. Z535.1 – Safety Color.

B. American Society of Mechanical Engineers (ASMA).

C. National Fire Protection Association (NFPA).

A. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS

A. Shop drawings.

B. Product Data:

1. Submit manufacturer's product literature information for products specified.

2. Manufacturer's Installation Instructions.

C. Operation and Maintenance Data.

D. Warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Show evidence that the firm has been engaged in producing such materials and products for at least 5 years and that the product submitted has a satisfactory performance record of at least 5 years.

B. Installer qualifications: Installer shall have 3 years of experience in installing these materials for similar projects and shall be approved by the manufacturer prior to bidding of the project.

C. Regulatory requirements:

D. As applicable, equipment of this Section shall comply with requirements of public agencies of the state of Missouri including ASME, NFPA, OSHA, and UL.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping: Deliver to the job site in manufacturer's original containers.

B. Delivery: After wet operations in building are completed.

C. Storage and protection:

1. Store materials in original, unopened containers in compliance with manufacturer's printed instructions.

2. Keep materials dry until ready for use.

3. Keep packages of material off the ground, under cover, and away from sweating walls and other damp surfaces.

4. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with a protective covering.

PART II PRODUCTS

2.01 EMERGENCY SHOWERS AND EYE/FACE WASHES

General design requirements:

A. Combination unit emergency shower with eye/face wash:
   a. Floor mounted fixture consisting of pipe standard, showerhead assembly, and eyewash assembly.
   b. Provide stanchion and floor flange, with interconnecting piping.
   c. Provide shower/eyewash unit with integral flow switch to alarm its use.
      1. Flow switch to be of all stainless steel construction.
      2. Showerhead flow: 20.0 gallons per minute flow, minimum.
      3. Eye/face wash flow: 3.0 gallons per minute flow, minimum.

4. Meet or exceed all requirements of ANSI Z358.1.
5. Provide ANSI compliant identification sign and markings.

B. Combination unit emergency shower and eye/face wash:

1. Manufacturers: One of the following or equal:
   a. Haws, Model No. 8309.
   b. Guardian Equipment, Model No. G1950HFC.
   c. Bradley, Model No. S19-310AC.

2. Pipe standard:
   a. 1-1/4 inch hot-dip galvanized steel pipe, and fittings with interconnecting piping, stanchion, and 9-inch diameter floor flange.
   b. Corrosion protection: Provide Haws "-CRP" or Guardian Equipment "-EC" epoxy protective coating in corrosive environments.

3. Shower head:
   a. Material and size: ABS plastic, 10-inch diameter.
   b. Valve and actuator: Stay open chrome plated brass ball valve equipped with stainless steel ball and stem operated by a rigid stainless steel pull rod.

4. Eye/face wash receptor:
   a. Valve and actuator: Stay open chrome plated brass ball valve with stainless steel ball and stem operated by a stainless steel or epoxy coated aluminum push handle and foot treadle.
   b. Spray head(s): ABS plastic or polypropylene eye/face wash type heads, with integral flip top protective dust covers releasing with water pressure.
   c. Receptor bowl: Stainless steel; 11 inches diameter.

5. Supply: 1-1/4 inch Industrial Piping Systems (IPS).

6. Waste: 1-1/4 inch IPS.

PART III EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturers' recommendations.

B. Install fixed equipment in accordance with manufacturer's instructions.

3.02 PROTECTION

A. Repair or replace defective equipment with new.

END OF SECTION

SECTION 16000
ELECTRICAL

Pages within this section are numbered separately.

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APPENDIX A

GEOTECHNICAL ENGINEERING REPORT

The Geotechnical Engineering Report can be viewed and downloaded by navigating to the following Website and searching by bidding event number or name:

https://www.cityutilities.net/bids

or go to

www.cityutilities.net and follow these links:
- For Business (top of page)
- Purchasing
- Bidding Opportunities
- Current Bidding Events & Awards Results
- All CU Bidding Opportunities
- **0000052882**

You will have access to open, print and/or save pdf file(s).

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PROJECT SPECIFICATIONS

FOR

CITY UTILITIES of Springfield

Booster II Elevated Tank

August 15, 2017

OWNER

City Utilites of Springfield
301 E. Central
Springfield, MO 65801
Ph. 417-863-9000

DESIGN FIRM

ESC, Inc. Consulting Engineers
1922 N. Broadway Avenue
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Ph. 417-831-5500
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August 15, 2017

City Utilities of Springfield
301 E. Central
Springfield, MO 65801

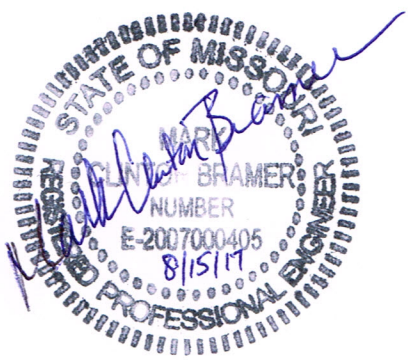
Project: Booster II Elevated Tank

It is hereby specified, pursuant to RSMo.327.411 that the documents intended to be authorized by ESC, Inc., and the undersigned's seal are limited to:

Drawings: E0, E1, E2, E3, E4, E5, E6, E7, E8, E9

Specifications: Electrical: 16010, 16011, 16111, 16115, 16120, 16130, 16141, 16170, 16175, 16180, 16190, 16195, 16425, 16461, 16470, 16481, 16510, 16520, 16525, 16900

and we hereby disclaim any responsibility for all other drawings, specifications, surveys, reports, instructions, construction directives, or other documents or instruments relating to or intended to be used for any part or parts of this project.



SECTION 16010
GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide all equipment, materials, labor and miscellaneous items required for a complete electrical and controls system including, but not limited to:

1. Power, lighting, receptacle, and distribution panels.

2. Low voltage feeder cables.

3. Lighting fixtures, emergency and exit lighting units, lighting contactors, photocells and lamps.

4. Motor lockouts, fusible and non-fusible disconnect switches, combination starters, receptacles, plugs, cords, cable grips, etc., for new and/or relocated devices.

5. Underground and above grade grounding systems.

6. Conduit, conduit fittings, seal fittings, expansion fittings, and supports.

7. Junction, pull and terminal boxes.

8. Wiring, conduit, electrical connections and installation (where required) of all equipment and controls furnished by this Contractor, subcontractors, or the Owner, including all control wiring and conduit for such equipment. All control wiring to be under direct supervision of subcontractor furnishing such equipment.

9. Supports required for conduit installation, supports required for the installation of the equipment furnished by this Contractor and equipment furnished by others but installed by this Contractor.

10. Motor overload heater elements.

11. "DANGER - HIGH VOLTAGE" warning signs for the outdoor and indoor electrical equipment, power distribution panels, and on all doors of all electrical equipment rooms.

12. “WARNING - ARC FLASH” warning labels and markers indicating voltage levels (e.g., 12.47KV, 277/480V,120/208V, etc.) for all of the electrical equipment such as panelboards, transformers, etc.

13. Modification of new and/or existing services to accommodate new and/or future work.

14. Electrical permits, fees for permits and all electrical inspections.

15. Site cleanup and legal disposal of all construction debris, all excess equipment, materials, or other items shall be removed.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. 16011 - Electrical Installation Requirements.

2. 16111 - Conduit.

3. 16115 - Duct Bank and Manholes.

4. 16120 - Wires and Cables.

5. 16130 - Electrical Boxes and Fittings.

6. 16141 - Wiring Devices.

7. 16170 - Grounding and Bonding.

8. 16175 - Disconnect Switches.

9. 16180 - Equipment Wiring Systems.

10. 16190 - Supporting Devices.

11. 16195 - Electrical Identification.

12. 16470 - Panelboards.

13. 16510 - Interior Luminaires.

14. 16520 - Exterior Luminaires.

15. 16525 - Emergency Lighting.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. Comply with the following standards.

1. ANSI American National Standards Institute.

2. FS Federal Specification.

3. ICEA Industrial Cable Engineers Association.

4. IEEE Institute of Electrical and Electronic Engineers.

5. IES Illuminating Engineering Society.

6. ISA Instrument Society of America.

7. NEC National Electrical Code.

8. NEMA National Electrical Manufacturer's Association.

9. NESC National Electrical Safety Code.

10. NFPA National Fire Protection Association.

11. OSHA Occupational Safety and Health Administration.

12. UBC Uniform Building Code.

13. UL Underwriter's Laboratories, Inc.

14. Federal, State and Local Codes.

1.04 SUBMITTALS FOR REVIEW

A. Prior to ordering equipment or starting any installation work, submit seven (7) copies of items proposed for this work with necessary illustrations, drawings, and engineering data for review by the Owner and/or Engineer. Submit in time to allow no less than seven (7) working days for review, checking, commenting and transmittal without delaying the construction schedule. Submit all items at one time no less than twenty (20) days after award of the contract.

B. Submittals shall be clearly marked to show the intended item, with identification as to the equipment number or other marking to show location, service, and function. All other extraneous and inapplicable information shall be marked out before submittal. Submittals not clearly marked to properly identify the equipment and application will be rejected and returned for immediate re-submittal by the Contractor.

C. The Contractor agrees that submittals reviewed and approved by the Owner and/or Engineer are not change orders; the purpose of submittals by the Contractor is to demonstrate to the Owner and/or Engineer that the Contractor understands the project design, and that this understanding is demonstrated by indicating the equipment and materials he or she intends to furnish and install and/or by the fabrication and installation methods he or she intends to use.

D. Requests for substitutions of materials and equipment shall be accepted only if request is made in writing at least seven (7) days prior to the bid date for the work. No substitution of materials, equipment, or other items shall be accepted without the written approval of the Owner. The Contractor accepts full responsibility for any resultant work change or additional expense, either directly or indirectly, that results from the improper and unapproved use of substituted materials or equipment.

E. Contractor further agrees that if deviations, discrepancies, or conflicts between submittals and contract documents are discovered, either prior to or after, submittals are to be processed by the Owner and the contract documents shall control and shall be followed. Submittals are required of all equipment and materials furnished on the project and shall include and be clearly marked as follows.

1. The name of the project.

2. Submittal date.

3. Names of contractors, subcontractors, suppliers, and manufacturers of materials and supplies.

4. All performance data for electrical equipment, including dimensional information and voltage, phase, operating and nameplate amperage of each electrical item such as motors, heaters, or other items. For motors, provide the manufacturer's nameplate information for review and approval.

5. If applicable, all auxiliary equipment, including various details to assure the intent of the work will be met.

6. Full description of capabilities and capacities of equipment, including but not limited to the manufacturer's drawings, cut sheets, data sheets, and other descriptive information.

7. MSDS information for all potentially hazardous chemicals and materials. Also, post a copy of the MSDS at the jobsite as required to indicate the required proper handling techniques and safety procedures for the materials.

1.05 SITE CONDITIONS

A. The Contractor must inspect the work areas, drawings and specifications and become thoroughly acquainted with the conditions which may be encountered during the installation of the work. No extra compensation or invoicing will be allowed to cover the work which has not been included in the bid due to failure of the Contractor to thoroughly examine the premises.

B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions may determine the actual arrangement of systems. Field measurements shall be taken and confirmed. The Contractor shall confirm accuracy of dimensions before fabrication and shall be responsible for all equipment and component layouts. Overhead work shall be laid out to obtain the maximum headroom. Coordinate the location of all electrical systems to avoid interference with the location of other systems or with traffic flow within the building. Confirm locations with the Owner prior to installation.

C. The Contractor is responsible for the daily inspection of the project work site for the presence of asbestos materials or for materials that may be asbestos contaminated. It is believed that there are no unknown asbestos materials on the work site. All known materials are marked indicating the presence of asbestos materials. The Owner knows of no potentially contaminated areas, piping system, duct system, etc. that might contain such materials. Contractor shall not allow employees or Owner's personnel to be exposed in any fashion to any unknown materials that may contain asbestos materials. Exposure to materials in question shall be completely avoided immediately. Contractor shall cordon off the area with "safety tape" to identify the potential risk and therefore limit exposure for others. The Owner shall be contacted immediately. The Owner will make immediate arrangements for the inspection of materials in question and, if necessary, for removal of same materials by an outside consulting firm. The Engineer has not been retained by the Owner to inspect the site for the presence of asbestos materials and therefore has no specific knowledge of the presence of such materials.

1.06 QUALITY ASSURANCE

A. Comply with all governing codes and regulations. Provide products of acceptable manufacturers that have been in satisfactory use in similar service for five (5) years. Use experienced installers. Deliver, handle, and store materials in accordance with the manufacturer's instructions.

B. The contract drawings for this work are in part schematic, intended to convey the scope of work and indicate the general layout, design and arrangement. The Contractor shall follow these drawings in the layout of his work and shall consult general construction drawings, mechanical drawings and all other drawings and specifications for this project to determine all conditions affecting the electrical work.

C. The contract drawings are not necessarily scaled and the Contractor shall verify adequacy and suitability of spaces in which the electrical work is to be installed. Contractor shall be fully responsible for the equipment installation layouts, orientation, clearances for access and maintenance, inspection, testing, finishing, safety, and other items for any equipment furnished.

D. Contractor shall also bare any additional costs pertaining to the Contractor requested alternative/change and shall not ask for additions monies, or cause other contractors or trades to request additional monies from the Owner as a direct or indirect result of the use of the

alternate/changes resulting from an alternate accepted by the Owner or Engineer. The Contractor shall be responsible for accuracy of dimensions and layout.

E. The Owner may appoint a representative as the Owner's Project Inspector and may inspect the work as it progresses. Any work or material rejected by the Inspector shall be removed and replaced with work or materials as specified or as shown on the drawings or as required by codes or industry standards at no additional costs to the Owner.

1.07 REGULATORY REQUIREMENTS

A. SPECIAL PART OF WORK: The Contractor shall strictly comply with all OSHA safety rules and regulations and use only approved equipment required for the performance of the work. The Contractor shall also strictly comply with all OSHA safety rules and regulations and use only approved methods of excavation, trenching, and shoring methods. The Contractor shall maintain and closely supervise safety practices and codes. EXTREME CARE shall be taken to safeguard the safety of the Public, the Owner's employees, and the Contractor's employees.

B. Fall protection on the job site must comply with all provisions of the OSHA standards.

C. Remove materials as specified or as required during the course of the work. Communicate with the Owner and verify the disposition plan with Owner. Dispose of all materials in a legal, acceptable, and proper fashion.

D. The Contractor shall be responsible for becoming familiar with local governing authorities having jurisdiction, codes, and statutes and, if required, shall obtain the required permits, pay all related fees including inspection fees, and obtain inspections as required to complete and finish his Work. The following codes shall be strictly be adhered to:

1. All OSHA requirements and guidelines including OSHA 29 CFR 1926 and 1910.

2. State and Local Building Codes.

3. State and Local Mechanical Codes.

4. State and Local Electrical Codes.

5. NFPA Standards.

6. Life Safety Codes and Standards.

7. ADA Requirements.

1.08 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Deliver, store, protect and handle products to the site. Obtain MSDS Sheets on chemicals and other materials upon delivery and provide training and documentation for all workers on construction site.

B. All electrical materials and related electrical equipment shall be inspected upon receipt for damage and manufacturing flaws. Any damage or flaws shall be duly noted and items returned to the supplying vendor or manufacturer or repaired satisfactorily. Shipment of the equipment shall be scheduled to avoid any delay in the construction schedule, as the construction schedule shall not be changed. As required, accept the materials on site in shipping containers with the labeling in place. Document the condition of materials upon receipt.

C. Store materials such that no danger exists from the potential of stacked materials falling on personnel or other materials.

D. Store all materials on pallets, shoring, or timbers as required to prevent the materials from resting on the ground or finished surfaces where damage to the materials or finished surfaces may occur. Protect, store, and handle all materials such that no spill may occur that can damage the environment in any fashion. Provide temporary protective covering or coatings for ferrous materials such as cast iron, steel valves, and other surfaces. Protect materials that may be damaged from freezing by storing in heated areas.

E. Provide temporary end caps or closures on conduit, fittings and equipment openings. Maintain the caps in place until installation. During handling and installation of the materials, protect electrical systems from entry of foreign materials by utilizing temporary covers, completing and closing sections of the work, and isolating parts of the completed system.

F. Damaged, lost or stolen materials shall be replaced by the Contractor at the expense of the Contractor.

1.09 COORDINATION

A. Coordinate work and activities at the site with the Owner during all work to provide adequate and timely access to all contract work areas with a minimal disruption of the Owner's activities and business needs. The Contractor shall be responsible for a scheduled sequence in performing the work so that it will not interfere with the Owner's operation. Before any work is started, the Contractor shall consult with the Owner and arrange a satisfactory work schedule. The Contractor shall make temporary alterations as required to execute the work so that all operations and services in the facility are maintained with the minimum possible interruption. Temporary shutdowns shall be minimized and shall be of the shortest possible duration. All facilities shall be kept in continuous operation unless specific permission to the contrary is granted in writing by the Owner. Daily scheduling and work location is a part of the Contractor’s work included herein.

B. The Contractor shall be responsible for coordination and cooperation with the Owner and other trades so that the installation is performed with minimum of interference and conflict. Particular attention must be paid to communication with the various trades regarding the planned installation of this work.

C. The Contractor shall be prepared to start, progress with, and complete the work as per the Owner’s project schedule and coordinating the activity of others performing project work.

D. The Contractor shall be responsible for the timely procurement of materials as specified in this specification. The Contractor shall schedule procurement of all materials so that they may be delivered and installed within the terms of the project schedule. Any difficulties in procurement affecting the intended schedule should be promptly reported to the Owner in writing.

1.10 WARRANTY

A. All materials, labor and system components shall be guaranteed for a minimum period of one (1) year from date of acceptance of work by the Owner, unless specified otherwise in other specifications. All equipment shall be covered by a separate warranty. Conflicts in stated warranty periods shall automatically default to the longest stated period. Should any mechanical or other related problem due to faulty materials or workmanship occur, the problem shall be corrected to the satisfaction of the Owner at no cost to the Owner. Any defective materials or inferior workmanship discovered at the time of installation and/or during the guarantee period shall be corrected immediately to the complete satisfaction of the Owner.

B. The Contractor shall further agree to repair or renew, free of charge to the Owner any part of the equipment that shall prove to be defective within one (1) year after the date of acceptance by the Owner.

C. The Contractor shall protect the equipment from damage and keep the equipment in an “as new” condition for all the furnished materials and equipment until final acceptance by the Owner.

1.11 TEST AND REPORTS

A. Instruct the Owner in the operation and maintenance of the electrical system.

B. Perform operational tests only on all lighting and 120 Volt receptacle circuits.

C. Inspect all ground connections for continuity and tight connections. Test resistance at various points on the grounding electrode system using a Biddle meter. Report any reading greater than 5 ohms to the Owner.

D. Check all control and interlocking wiring for proper operation. Perform operational tests with the Owner to assure that control wiring has been properly installed.

E. Submit a list of motors that require an overload heater with the following data.

1. Motor designation.

2. Horsepower, voltage, phase, and service factor.

3. Nameplate full load amperes.

4. Manufacturers catalog number of heater selected.

5. During this work, verify that overload relays are set on "MANUAL" reset.

F. Before energizing any panelboard or switchboard.

1. Remove all construction dirt and debris.

2. Check that wiring is not resting against sharp edges of the enclosure.

3. Conduct insulation tests between busses and between bus and ground.

4. Verify that overcurrent devices have proper ratings and settings.

G. Test ground-neutral separation, in the presence of the Owner, by the following.

1. Disconnect power.

2. Remove the main neutral ground bonding jumper ahead of the main.

3. Measure the resistance between the neutral bus and the grounding bus of the service entrance.

4. In an open circuit reading is obtained, test each transformer feeder, one at a time as follows.

a) Disconnect the bonding jumper between the transformer secondary neutral lug and the bonding jumper.

b) Measure the resistance between the transformer secondary neutral lug and the transformer ground lug.

c) If 4b gives an open circuit reading, restore the system by reversing the above procedures. All bonding jumpers shall be replaced.

H. Submit ground fault protection system testing as required by the National Electrical Code.

I. Check rotation on all motors and reverse rotation if necessary.

J. Check rotation of all utility services and building generator sources to assure proper phase rotation.

1.12 PROJECT CLOSEOUT

A. Adequately instruct the Owner's personnel in the proper operation and maintenance of each system and equipment item.

B. Provide the Owner three (3) sets of Operation and Maintenance Manuals for each system or equipment item. The various items for each manual shall be bound together in one plastic comb bound booklet or heavy-duty three (3) ring binder.

C. Provide for the reuse by the Owner or proper disposal of excess materials as required to approved locations on the site or for disposal as required if no acceptable place for disposal exists on the site. The hauling, handling, confirmation, coordination, and management of this activity is wholly the responsibility of the Contractor.

D. Furnish record drawings of the final installation noting important data during and after the final installation is complete and systems are operational. Record drawings shall be thorough with attention to details. The Owner retains the right to request more information to be added to drawings as needed. Record drawings shall be clearly marked with an erasable red lead pencil.

E. Copies of all project closeout documents shall be forwarded to the Owner for review, approval, and use.

PART 2 - PRODUCTS AND MATERIALS

2.01 MATERIAL STANDARDS

A. All products shall be first-line quality, new and unused of the grade and type as shown on the drawings and as specified, or the equivalents as approved by the Owner in writing.

B. All products shall be in current production with no notice having been given that this product is to be drastically changed, modified, or discontinued from production.

C. When any material or equipment is identified on the plans or in the specifications by reference to one manufacturer's name or model number, it is intended to establish the required standard of design and quality, and it is not intended to limit competition. It is understood that, whether present or not, the phrase "or equivalent" or "or an approved equivalent" applies to all furnished materials and is meant to mean an "accepted" equivalent if approved by the Owner and Engineer prior to bidding project.

2.02 MATERIAL ALTERNATIVES

A. If the Contractor desires to suggest changes, modifications or alternatives, the Contractor shall submit, in writing, a description of the proposed changes or modifications for review by the Owner and Engineer.

B. The Contractor shall submit to the Owner for approval three (3) copies of descriptive information for any materials proposed by the Contractor which are not exactly as specified and are intended to be equivalent or better in quality or performance. The information shall include, as a minimum, catalog data sheets and shop drawings, samples and other supportive information as necessary for the Owner to evaluate the proposed materials or equipment.

C. The Owner shall review alternative material and equipment recommendations and shall be the sole judge in determining whether the proposed material, accessory, or item meets the stated criteria for the service and conditions imposed. The Owner may request the Engineer to provide an opinion regarding such issues.

D. The Contractor shall not proceed with any proposed changes or modifications until authorized to do so by the Owner in writing. The cost of any work performed on proposed changes or modifications without the Owner's written approval will be at the Contractor's expense, as well as any cost for undoing such unauthorized work.

E. Acceptance of requests for substitutions of equipment, materials or processes specified will be contingent upon submission of proof, satisfactory to the Owner that (1) they are satisfactory in terms of quality and serviceability; (2) their use will not entail changes in details and construction of related work and (3) they are acceptable in consideration of the required design. The burden of proof shall be upon the party proposing the substitution. No consideration will be given to incomplete submittals.

F. The Contractor is encouraged to suggest alternates covering each of the following subjects.

1. Alternative materials and equipment to improve quality, schedule or reduce pricing.

2. Exceptions to the specifications covering materials and equipment, manner of application, or other details.

PART 3 - EXECUTION OF WORK

3.01 EXAMINATION AND INSPECTION

A. Prior to bidding the work, the Contractor shall visit the site and become fully familiar with all conditions such as overhead and underground obstructions, structures, equipment, and other items that pertain to the work described herein. Failure to understand or have knowledge of issues that could have been determined prior to bidding will not constitute grounds for asking for work change orders or extra work.

B. Verify field dimensions, routing, clearances, access, heights, schedules, and other times by field inspection and site assessment prior to beginning the work.

C. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for the electrical work. Site conditions may determine the actual arrangement of systems. Contractor shall be responsible for accuracy of dimensions and layout. Overhead work shall be laid out to obtain maximum headroom. Coordinate the location of all systems to avoid interference with the location of other systems, work of other trades or with traffic flow within the areas.

D. Where specific details and dimensions for the work are not shown on the drawings, the Contractor shall take measurements and make layouts as required for the proper installation of the work and shall provide coordination with all other work on the project. In case of any discrepancies between the drawings and the specifications that have not been clarified by addendum prior to bidding, it shall be assumed by the signing of the contract that the higher cost (if there is any difference in costs) is included in the contract price, and the Contractor shall perform the work in accordance with the drawings and with the specifications, as determined and approved by the Owner/Engineer, and no additional costs shall be added to the contract price.

E. The Contractor shall examine the areas and conditions under which this work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected. The starting of work is acceptance of the conditions within any particular area.

F. The Contractor shall take extra precautions to protect the floors, roofs, and ground from oil spillage and dripping. Any operation, such as cutting and threading of pipe that can result in dripping of oil and thread cuttings shall be done over a drain pan that will collect all drippings. Tarpaulins, plywood or drop cloths shall be used around such piping to prevent workers from tracking oil over the area. Workers shall be cautioned about cleaning their shoes. Any liquids, such as oil, that will be used in this work shall be kept in tightly stoppered containers; and extreme care shall be used when charging equipment with these materials so as to avoid any spills.

3.02 INSTALLATION

A. Work under this division of the specifications shall consist of the furnishing of all labor and materials necessary for the complete installation of all electrical and controls systems as shown on the drawings, as specified herein, and as required for a complete and operational system. The Contractor shall furnish and install all minor items that are obviously required and reasonably necessary for the work. The Contractor shall drill, cut, or otherwise attach components for installation of the work with the full understanding that the Contractor is responsible for leaving the finished areas in an “as original” condition. Caulking, filling, touch-up painting and other surface finish around the Contractor’s work and work area is therefore within the scope of work of this specification. All work shall be completed and ready for full operation.

B. Install all materials and systems in accordance with manufacturer's instructions and as per the approved submittals. Install materials in proper relationship with adjacent construction and with a uniform appearance for exposed work. Coordinate the installation with the work of other sections. Comply with all applicable regulations and building code requirements.

C. Restore damaged finishes. Clean and protect the work from damage during construction and clean the final work at project completion. Any damaged, scratched, marred, or otherwise defaced painted surfaces, walls, ceilings, roofs, floors, doors, insulated surfaces or insulation coverings or finishes, or other items shall be so repaired to restore the finish to original condition by personnel working in the required respective trade.

D. If required, install approved fire stop materials around all pipe and duct material penetrations through fire rated walls and floors.

E. It is the intent that all materials and material surfaces have a protective finish when in place. All non-galvanized ferrous metal items inside the building exposed to weather or other area subject to rusting shall be given one heavy coat of rust preventive primer at the time of initial installation to prevent rusting or corrosion prior to final painting.

3.03 PENETRATIONS, CUTTING AND PATCHING

A. For all work, this specification governs the minimum requirements for the material procurement, labor, supervision, tools, and equipment necessary for penetration of the building elements. Work to be performed shall include the complete and proper penetration of building elements as shown on the drawings and as necessary to properly install an operating system.

B. Penetrations through the exterior wall shall be flashed and water tight, and allow for the normal conduit movement. For non-fire rated walls, pack around both conduit with fiberglass and caulk with a compound to create watertight seal. For fire rated walls, seal as required to provide the full fire rating capacity of the fire rated assembly. If applicable, the location of fire rated walls and floors will be provided by the Owner.

C. Holes in masonry shall be drilled with a suitable diamond-core-bit rotary drill. Wall sleeves through concrete shall be grouted and installed with four 1 1/2 inch anchoring lugs. Air hammers shall not be used. Openings shall be made by coring, sawing, or other methods as approved by the Owner.

D. Permission to patch any areas or items of work shall not constitute a waiver of the Owner's right to require complete removal and replacement of said areas or items of work, if, in the Owner's opinion, said patching does not satisfactorily restore the quality and appearance of same.

3.04 EQUIPMENT PADS

A. All floor-mounted equipment shall be mounted on equipment pads, unless otherwise indicated on the drawings. When concrete equipment pads are required, the Contractor shall verify the size and location of the pad with the Owner or the Engineer.

B. Unless noted otherwise on the drawings, all pads shall be level, 3 1/2 inch high minimum and shall extend 2 inches beyond the equipment base on all sides unless equipment is mounted against a wall in which case the equipment pad shall not have an extension in the wall direction. Pad sizes shall be based on actual equipment size.

C. Anchors shall be Phillips Red Head. Install two anchors for each 4 feet of equipment length or a minimum of four anchors. Bolt equipment to pad using machine screws and washers.

D. Grouting shall be done under this section after the equipment is installed and leveled. Grouting material shall be non-metallic structural non-shrink grout. Grout shall be mixed and placed in accordance with the manufacturer's recommendations. Leveling shims and wedges shall be removed after the grout has hardened. Shim or wedge areas shall be re-grouted.

3.05 GROUNDING

A. All equipment shall be grounded by connecting the equipment ground or housing to the building grounding system with a properly sized conductor.

B. All current carrying equipment shall be connected to the ground system. This shall include, but not be limited to, transformers, panels, motor frames, motor controllers, and starters.

C. Every conduit carrying power circuits shall have separate ground wire(s) run with the power wires regardless of conduit material.

D. Unless otherwise shown, a separate grounding wire shall not be required in control circuit raceways.

END OF SECTION

SECTION 16011
ELECTRICAL INSTALLATION REQUIREMENTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The furnishing of all labor, supervision, tools, and expendable materials, etc., required for the installation of the complete electrical systems as shown on the electrical drawings, specifications, and standards.

B. The furnishing, delivery, unloading, handling and installation of all electrical materials and equipment not specifically indicated as being furnished by others.

C. The unloading, handling and installation of all electrical materials and equipment furnished by others. That equipment which is being furnished by others will be delivered to the plant site. The Contractor shall be held strictly accountable for any damage or loss of such equipment and shall replace or repair the same at his own expense. Any such repair shall be subject to approval. The Contractor shall inspect all equipment and material furnished to him for damage, missing parts or other deficiencies and shall call these to the attention of the company.

D. The storing in a weathertight dry enclosure, if necessary to preserve the quality and operating condition, of all electrical equipment and material. The storage areas shall be subject to inspection and approval.

E. The testing and adjusting of all electrical equipment and material, including all equipment and material furnished by others, in accordance with the testing portion of this specification.

F. The furnishing of any temporary electrical facilities that construction may require.

G. The removal of the complete temporary electrical facilities system at the close of construction; that which is presently installed and any additions installed during the contract. All material removed shall remain the property of the Owner.

H. All labor, tools, equipment and material for excavation and backfill that may be required for the installation of the electrical system. Excavation shall be backfilled and compacted to match surrounding terrain, and any sod, concrete, asphalt, shell, gravel, or other excavated surface shall be replaced to match existing.

I. The furnishing, location and installation of all support material required for all electrical equipment and raceways.

J. The furnishing of all labor necessary to mechanically and electrically assemble and connect electrical equipment that has been disassembled by the manufacturer for shipping purposes. This work shall be done in complete accordance with manufacturer's drawings and instructions.

K. The functional check of all equipment and instrumentation normally included in the electrical scope of the work.

1.02 RELATED SECTION AND DOCUMENTS

A. The following section contains requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

1.03 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

1.04 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.05 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

1.06 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.07 MATERIAL DELIVERY, HANDLING, STORAGE, AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for materials information.

1.08 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.09 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.10 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

PART 2 - PRODUCTS AND MATERIALS

2.01 MATERIALS

A. All materials shall be new and free of defects and shall be of the best quality of their respective kinds. Material of a classification as listed by Underwriters Laboratories or Factory Mutual System shall be so approved for the required service.

B. Where several approved manufacturers are shown for one type of material, all material of that type is to be of the same manufacturer.

C. All materials, equipment and methods of installation shall be approved by the Owner.

D. Where specific manufacturers are mentioned in the specifications or drawings without qualifications as to an alternate, that particular make or catalog number only will be acceptable

E. Where an item is specified as a particular type "or equivalent" or "or approved equivalent", the Owner or their Representative shall approve any proposed substitution.

F. Any "substituted" material or equipment installed without prior approval of the Owner or their Representative shall, if so directed by same, be removed and replaced with approved material or equipment at the Contractor's expense.

G. Where construction materials are furnished by others in bulk quantities, the Contractor shall be responsible for making up shortages with material of identical quality and manufacture.

H. The Contractor shall be responsible for furnishing all electrical materials shown on the electrical drawings unless specifically mentioned as furnished by others.

I. The Contractor shall furnish and install that material and equipment which is not specifically mentioned or shown but which is necessary for a proper complete system. This material and equipment shall include but not be limited to the following:

1. All hardware for support of conduits and other electrical equipment.

2. All conduit lock nuts, bushings, and nipples.

3. All conduit "U" bolts.

4. All conduit clamps and conduit beam clamps.

5. All electrical insulating tape and wire markers.

6. All nuts, bolts, anchors, machine screws and threaded rods.

7. All miscellaneous structural steel shapes such as channel, angle and plate as specified on the drawings.

8. All expendable materials such as conductive thread lubricant, cutting oil, pulling lubricant, chalk, wire, rope, etc.

PART 3 - EXECUTION OF WORK

3.01 CONDUIT AND FITTINGS

A. Conduit shall bear the label of the Underwriters Laboratories, Inc.

B. All conduit shall be installed in an orderly manner. Conduit arrangement shall be such that a minimum of crossovers will result. Exposed conduits shall be run parallel to the lines of the surrounding structure.

C. Conduits shall be installed in a manner which will permit installation of conductors without damage after conduit system is complete.

D. Conduits shall be free from dirt and foreign materials before pulling conductors into them. Incomplete conduit ends shall be plugged as soon as the conduit is installed to prevent entrance of debris during construction.

E. Spare conduits shall be blown clear of all foreign materials and capped with standard fittings at ends not permanently protected by other means such as covered junction boxes.

F. Ends of conduits shall be reamed after cutting to insure a smooth inside surface for the conductors except for close instrument conduit work.

G. Conduits shall be sized as specified on drawings but shall not be smaller than 3/4 inch.

H. Where vertical conduit runs exceed 50 feet, suitable cable supports shall be installed.

I. Bends in conduit shall be made while cold and in no case shall conduit be heated. No conduit which is crushed, deformed or otherwise injured shall be installed. Bends in conduit shall be symmetrically formed and neat in appearance. Minimum radius of bends shall be eight (8) times the nominal conduit size. In no case shall the conduit be bent through more than 90 degrees.

J. Where conduits cross building expansion joint or between buildings, a suitable expansion fitting will be used.

K. Contractor shall furnish all necessary conduit, conduit straps, clamps, fitting and supports for the conduit. Conduit support spacing shall be not more than 8 feet centers. Conduit racks shall be assembled as necessary using angle and U-bolts.

L. The complete conduit system including fittings, pull boxes, and junction boxes shall be installed in such a manner that the entire system is watertight.

M. All conduits, when grouped in racks of two or more, shall be installed with concentric bends for off site and 90 degrees ells are permissible where single runs are installed.

N. Where conduits enter boxes, or equipment not supplied with threaded hubs, Myers Hubs shall be used.

O. In general, the exact location and routing of conduit shall be determined by the Contractor, and approved by the Owner or their Representative before work is started.

P. Conduit shall not be run in close proximity to hot surfaces or piping. A minimum of 12 inch clearance shall be maintained between parallel runs of conduit and hot surfaces or piping, and 6 inches when conduit crosses hot piping.

Q. Conduit shall be run parallel to, or perpendicular to, walls, ceilings or structural members.

R. All conduit threads and threaded connections shall have an application of conductive thread lubricant (Crouse-Hinds Co. type "STL" or approved equivalent) before assembly of conduit system.

S. In general, conduit fittings (conduit bodies) shall be threaded, made of a cast ferrous material with cast ferrous covers and solid neoprene gaskets.

T. Pull boxes shall be Hoffman or approved equivalent and shall be installed as required to permit wire installation without damage, and to limit the number of 90 degrees bends(or equivalent) to four (4).

U. Drain seals for outdoor conduit systems shall be installed in vertical conduits entering the top of equipment enclosures within 12 inches of the enclosure top. Vertical conduit entering the sides of equipment enclosures shall use a "tee" fitting with a drain fitting plugging one end, with a nipple into the enclosure. All vertical conduit drops over 8 feet shall be equipped with a drain fitting at the lowest point. Bottom entered equipment enclosures shall be equipped with standard drain and breather fittings in the enclosure bottom.

V. Field bends shall be made with approved bending tools or machines. Minimum bending radius shall be 18 inches for 1 1/2 inch and 2 inch conduits, 24 inches for 2 1/2 inch, 3 inch and 4 inch conduits unless specified otherwise on the drawings. Minimum radius for other sizes shall be per NEC or as required by field conditions.

W. Conduit shall not be supported from piping unless specifically approved by the Owner.

X. In Class I and II hazardous area locations, sealing fittings shall be provided in accordance with Articles 500, 501 and 502 of the National Electrical Code.

3.02 UNDERGROUND CONDUIT

A. All underground conduit shall be direct buried at least 24 inches below grade.

B. Conduit installed underground shall be one trade size larger than is normally required for above ground work. (Minimum size 1 inch).

C. Care shall be exercised during excavation operations for underground conduit to prevent damage to existing structures, underground piping and conduit.

3.03 CABLES AND WIRES

A. Wire smaller than No. 12 AWG shall not be used for any part of the power systems except the wire for the control circuits which shall be No. 14 AWG or as noted on drawings. All conductors throughout shall be coded in accordance with the National Electrical Code. Neutral conductors shall be colored white: one extra green wire, No. 12 stranded, shall be run for grounding of duplex receptacles.

B. All wire and cable shall have stranded copper conductors.

C. Ground conductor shall be green stranded copper Type THHN, 600 Volt of size shown on the drawings.

D. All wires and cables required for the work shall be installed continuous, without splice from source of supply to distribution equipment.

E. All wires shall be continuous without joints or splices. Wherever joints or splices are necessary, they shall be made in approved junction boxes or fittings with ample space available.

F. Cable on reels and wire in coils shall be protected from damage be construction activities. Cable shall be stored in a clean, dry area. When stored for a period of time, the ends of cables on reels shall be taped. Cable over 600 Volts shall be sealed per manufacturer's instructions.

G. Conductors shall be carefully handled during installation to avoid damage of any kind. They shall be unreeled or uncoiled slowly in order to prevent damage to the insulation or sheath due to sudden bending. Repeated bending shall be avoided. Sharp kinks shall be avoided in unreeling, uncoiling, and pulling. Manufacturer's minimum bending radius recommendations shall be observed.

H. The pulling of wiring into conduits and underground duct shall be done with all possible care. The cable reels or coils shall be set up in such a way that the conductor may be trained into the raceway as directly as possible with a minimum number of changes of direction or amount of bending.

I. The raceway termination shall be provided with a protector to guard against damage to the conductor covering. Where several cables are contained in one conduit, all such cables shall be pulled in together.

J. Wire insulation shall continue to within 1/8 inch of clamp type terminal or box type connector. Termination of wire at terminal blocks shall be by bare wire if the terminals are suitable for this type of connection. Where screw type terminals are provided, connectors shall be insulated ring type.

3.04 GROUNDING SYSTEM

A. The ground system shall be installed in strict accordance with the National Electrical Code, job specification and drawings.

B. Main ground loop (No. 4/0 AWG) cable shall be bare copper cable type.

C. Unless noted otherwise on the drawings, or impractical because of site conditions, underground ground cable shall be a minimum of 18 inches below grade.

D. Where ground cables rise through concrete to point of connection the cable shall be mechanically protected by the use of a PVC conduit sleeve extended through the concrete slab.

E. Ground rods shall be copper weld and shall be 3/4 inch diameter and 10 feet long threaded sectional.

F. If the measured resistance to ground does not meet the required value, extension shall be coupled to the rod, and if necessary, additional rods spaced 10 feet apart shall be driven and connected by number 4/0 AWG stranded copper cable buried at least on foot below ground level. If more than three sets of rods are required , a ground mat shall be constructed.

G. A ground mat shall be constructed by driving ground rods every 10 feet in a rectangular pattern. A grid shall then be established by connection the tops of all ground rods in a crisscross pattern with number 4/0 AWG minimum bare stranded copper cable. The grid of cable shall be one foot minimum below the surface or to a greater depth if necessary to prevent mechanical injury. The measured resistance of the complete mat shall not exceed the required value.

H. A test point shall be provided to facilitate measurement of resistance to ground.

I. All cables used shall be No. 4/0 AWG stranded copper, green TW insulated as indicated on the drawings unless otherwise specified.

J. All ground cable connections shall be made by the Burndy Thermoweld or Cadweld Process unless otherwise indicated on the drawings. The connections, when made, shall be checked for mechanical strength and high electrical conductivity. All grounding connections shall have a non-corrosive sealing compound applied over them shortly after being completed and shall be taped.

K. At least one below ground test well shall be installed unless otherwise directed by the Owner or Engineer.

L. Resistance of equipment shall be 5.0 ohms or less.

M. Clean off paint, foreign materials, etc., down to bare metal.

N. Install proper size Burndy type YA-V or YA-L lug on ground conductor.

O. Bolt ground conductor to metal framing, enclosure, pothead, ground bus, etc., using brass bolts, nuts, and washers.

P. Metal or wire fences shall be grounded on both sides of each gate. The connection between the fence and a ground rod shall be made with No. 2/0 AWG stranded copper wire.

Q. Grounding connections to equipment shall be made with lugs bolted to the equipment. Anchor bolts shall not be used for this purpose.

3.05 FINISH

A. All support steel, hangers, miscellaneous steel hardware, etc. furnished by the Contractor shall be galvanized.

B. Burned, cut or otherwise marred galvanized surfaces shall be repaired using a zinc rich paint in accordance with job specifications.

C. All scratched or defaced equipment shall be touched up and repainted to match original finish.

3.06 MISCELLANEOUS

A. All above grade electrical penetrations or openings through block walls, siding, concrete floors, roofing, etc. shall be environmentally sealed.

3.07 IDENTIFICATION AND LABELING

A. Each item of electrical equipment shall be provided with an identification tag showing its item number and service. Identification shall be as directed by the Owner.

B. Provide and affix suitable durable electrical hazard warning signs and other electrical safety signs as required to comply with OSHA regulations or as directed by the drawings.

3.08 TESTING

A. This section provides for the testing of electrical cables, switchgear, transformers, the calibration of adjustable trip devices on molded case circuit breakers, and calibration of electrical instruments and meters.

B. All testing and calibration work covered in this section of specifications shall be performed by a testing firm approved by the Engineer and specializing in such work employing instruments and testing devices designed for the purpose.

C. The electrical contractor shall provide labor as required to assist the testing firm in performing its work. Institute and maintain rigorous safety precautions for all test procedures requiring application of potentials above 30 Volts. Erect barricades around danger areas, post suitable warning signs and station watchmen as necessary to insure that unauthorized persons do not approach energized conductors.

D. In addition to the requirements of this specification, manufacturer's instruction and operating manuals shall be consulted for additional tests, checks, and inspections.

3.09 SCOPE OF TESTING

A. Test the following apparatus and cables.

1. 600 Volt cable.

2. Low voltage circuit breakers.

3.10 INSPECTION AND EVALUATION

A. All electrical equipment shall be inspected for the following, and all defects corrected.

1. Proper installation, support and fastening.

2. Complete assembly of all components, all shipping material removed.

3. Tightness of bolted covers, proper gasket fit and missing bolts.

4. Tightness and physical condition of all bolted connections, both electrical and structural.

5. Proper support and termination of power leads.

6. Damage to equipment exterior including paint finish.

7. Cleanness inside and out.

8. Any other inspections recommended by the equipment manufacturer in his installation instructions and/or manuals.

B. Testing evaluation should be as follows.

1. Test results shall be submitted to the Owner's Engineer before circuits or equipment are energized for the first time.

2. Individual measurements which fall below the average of like measurements on similar equipment by more than 25 percent shall be submitted to the Owner's Engineer for specific approval, even though they meet the minimum acceptable values.

3. If transformers must be dried to obtain required insulation-resistance values, approval of the drying method shall be obtained form the Owner's Engineer before applying heat.

C. The Owner's Engineer reserves the right to witness all tests, and he shall be notified one week before tests are to take place.

D. Test reporting shall comply with the following.

1. Four certified copies of the test data shall be given to the Owner's Engineer.

2. The report for each test shall include the date of performance and name of the person in charge of the test.

3.11 GROUNDING SYSTEM

A. A visual inspection of all grounding shall be made to insure all connections.

B. Grounding system shall be tested using a Biddle Co. tester or approved equivalent using the fall-of-potential method. Maximum acceptable resistance reading shall be 5 ohm.

3.12 CONDUIT

A. Visually examine conduit system for the following and correct all defects.

1. Adequate support for conduit and equipment.

2. Plugs in all unused conduit and junction box openings.

3. Covers in place and properly tightened on all conduit fittings and junction boxes.

4. Drains properly installed.

5. Gaskets installed as required.

END OF SECTION

SECTION 16111
CONDUIT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide conduit systems including, but not limited to:

1. Metal conduit.

2. Flexible metal conduit.

3. Liquidtight flexible metal conduit.

4. Nonmetallic conduit.

5. Flexible nonmetallic conduit.

6. Fittings and conduit bodies.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

2. Section 16130 - Electrical Boxes and Fittings.

3. Section 16170 - Grounding and Bonding.

4. Section 16190 - Supporting Devices.

5. Section 16195 - Electrical Identification.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. Comply with provisions of the following codes.

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.

2. ANSI C80 - Intermediate Metal Conduit.

3. ANSI C80.5 - Rigid Aluminum Conduit.

4. ANSI C80.3 - Electrical Metallic Tubing.

5. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

6. NEMA RN 1 and UL 6 - PVC externally-coated galvanized rigid steel conduit and intermediate metal conduit.

7. ANSI/NFPA 70 - National Electrical Code.

8. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

9. Underwriter's Laboratories (UL) - Pertinent Standard, Approvals and Listing.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

1.05 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.06 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.07 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for material information.

1.08 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.09 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.10 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

PART 2 - PRODUCTS AND MATERIALS

2.01 CONDUIT REQUIREMENTS

A. Minimum size: 3/4 inch unless otherwise specified.

B. Exposed conduit shall be rigid galvanized steel where subject to damage. Concealed or protected conduit may be electric metallic tubing or intermediate metal conduit.

C. PVC externally-coated conduit shall be used in corrosive environments and as specified.

D. Underground conduit shall be nonmetallic PVC conduit direct buried 24 inches below grade or encased in 2500 psi concrete as shown on the drawings.

2.02 METAL CONDUIT

A. Rigid steel conduit (RGS): ANSI C80.1.

B. Rigid aluminum conduit: ANSI C80.5.

C. Electric metallic tubing (EMT): ANSI C80.3.

D. Intermediate metal conduit (IMC): ANSI C80.

E. Fittings and conduit bodies: ANSI/NEMA FB 1.

2.03 FLEXIBLE METAL CONDUIT

A. Description: Interlocked steel construction.

B. Fittings: ANSI/NEMA FB 1.

2.04 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Description: Interlocked steel construction with PVC jacket.

B. Fittings: ANSI/NEMA FB 1.

2.05 PVC EXTERNALLY COATED CONDUIT

A. The PVC coated conduit, boxes, and fittings must be UL listed. The permitted PVC coating must have been tested and approved by UL as providing the primary corrosion protection for the rigid metal conduit.

B. Applicable UL Standards may include: UL 6 Standard for safety, Rigid Metal Conduit, UL 514B Standard for Safety; Fittings for conduit and outlet boxes.

C. The PVC coated galvanized rigid conduit must be ETL Verified to the Intertek ETL SEMKO High Temperature H_2O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.

D. Acceptable manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work included, but are not limited to, the following:

1. Robroy Industries.

2. Perma-Cote.

3. Plasti-Bond.

2.06 NONMETALLIC CONDUIT

A. Description: NEMA TC 2; Schedule 40 PVC.

B. Fittings and conduit bodies: NEMA TC 3.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION REQUIREMENTS

A. Install conduit in accordance with the National Electrical Code (NEC) latest edition.

B. Install nonmetallic conduit in accordance with manufacturer's instructions.

C. Arrange supports to prevent misalignment during wiring installation.

D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

E. Group related conduits.

F. Fasten conduit supports to building structure and surfaces under provisions of Section 16190 - Supporting Devices.

G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

H. Arrange conduit to maintain headroom and present neat appearance.

I. Route conduit parallel and perpendicular to walls.

J. Maintain adequate clearance between conduit and piping.

K. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

L. Cut conduit square using saw or pipe cutter; de-burr cut ends.

M. Bring conduit to shoulder of fittings; fasten securely.

N. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for a minimum of 20 minutes.

O. Use conduit hubs to fasten conduit to cast boxes.

P. Install no more than equivalent of three (3) 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inch size.

Q. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system where exposed to outdoor elements.

R. Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.

S. Provide suitable pull string in each empty conduit except sleeves and nipples.

T. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

U. Ground and bond conduit under provisions of Section 16170 - Grounding and Bonding.

V. Identify conduit under provisions of Section 16195 - Electrical Identification.

W. Only fittings listed as concrete tight by Underwriter's Laboratories shall be used in concrete.

X. All conduits terminating in vertical risers shall have the vertical run and the first bend to the horizontal run made of hot-dipped galvanized rigid steel conduit. A 48 inch minimum radius elbow shall be used.

END OF SECTION

SECTION 16115
DUCT BANK AND MANHOLES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide duct bank and manholes including, but not limited to:

1. Underground duct system consisting of banks of nonmetallic or metallic ducts.

2. All necessary earth and rock excavation and backfill.

3. Removal and disposal of all excess excavation material.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

2. Section 16111 - Conduit.

3. Section 16170 - Grounding and Bonding.

1.03 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

1.04 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.05 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

1.06 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.07 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for material information.

1.08 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.09 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.10 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

PART 2 - PRODUCTS AND MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. Duct spacers

1. Carlon Products Division.

2. CertainTeed.

3. Formex.

2.02 DUCTS

A. As specified in section 16111 - Conduit.

B. Provide with all necessary end bells, couplings, offset couplings, elbows, plugs, and other fittings.

C. Prefabricated, interlocking type plastic duct spacers and caps for duct spacing as indicated.

D. Rigid galvanized steel large radius elbows for all duct termination risers.

E. PVC duct for all straight and horizontal radius ducts. Rigid galvanized steel for all vertical riser elbows.

2.03 “PULLING - IN” ROPE

A. Nylon or polypropylene.

B. Minimum breaking strength: 2,000 pounds.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION

A. Duct banks

1. Ducts: Assemble as follows

a) Use spacers to maintain horizontal and vertical separation as indicated. Maximum longitudinal distance between spacers for PVC duct shall be 5 feet. Maximum longitudinal distance between spacers for rigid steel conduit shall be not greater than 3 feet.

b) Stagger joints in adjacent ducts.

c) Make all joints watertight by application of joint sealer compound furnished by duct manufacturer.

d) Do not put reinforcing steel or other ferrous material between individual ducts.

e) Securely tie overall and anchor to prevent flotation at 5-foot intervals.

f) After assembly, align ducts so that they do not vary from the drawings more than 4 inches in the horizontal or vertical plane.

g) Provide all duct bank terminations with end bells, installed flush with face of concrete.

h) Cap ducts installed and not terminated for future extension by others, and leave ready for said extension.

2. Minimum radius for horizontal bends: 50 feet.

3.02 CLEANING

A. Rod and clean all ducts with swabs and mandrels after installation of the duct bank and install pulling ropes. After ducts are cleaned and pulling ropes are installed plug each end of all ducts.

3.03 BACKFILLING

A. Backfill as specified.

END OF SECTION

SECTION 16120
WIRES AND CABLES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide wires and cables including, but not limited to:

1. Wires and cables rated 600 Volts and less.

2. Connectors.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

2. Section 16130 - Electrical Boxes and Fittings.

3. Section 16470 - Panelboards.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. Provide components which are listed and labeled by UL under the following standards.

1. UL 83 - Thermoplastic Insulated Wires and Cables.

2. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.

3. UL 854 - Service Entrance Cable.

B. Provide components which comply with the following standards.

1. WC-5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

2. WC-7 - Cross-Linked Thermosetting Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

3. WC-8 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

4. Std 82 - Test Procedures for Impulse Voltage Tests on Insulated Conductors.

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

B. Submit manufacturer's product data and part numbers for all cables, wire connectors and terminations.

1.05 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.06 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

B. Conform to requirements of ANSI/NFPA70, National Electrical Code (NEC) latest edition.

C. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.

1.07 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for material information.

1.08 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.09 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.10 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

PART 2 - PRODUCTS AND MATERIALS

2.01 WIRE AND CABLES

A. Provide wire and cable suitable for the temperature, conditions and location where installed. 40 degrees C shall be used as the ambient unless otherwise noted.

B. Conductors 10 AWG and smaller shall be 600 Volt copper THHN/THWN. Branch wiring to wiring devices and lighting fixtures may be solid or stranded. All other wiring, including motor and control wiring, shall be stranded.

C. Conductors 8 AWG and larger shall be 600 Volt stranded copper THW unless noted otherwise.

D. Wiring to H.I.D. lighting fixtures without a prewired junction box shall meet the temperature classification as required by the U.L. label for the fixture.

E. Cords for making connections to equipment shall be 600 Volt, heat resistant, thermoplastic insulation, oil-resistant thermoplastic, type STO of extra flexible stranded copper.

F. Minimum size wire for lighting and branch circuits shall be 12 AWG.

G. Minimum size wire for control shall be 14 AWG, unless otherwise noted on the drawings or in this section.

H. Color coding for phase identification of conductors shall be in accordance with Table 1.

I. Acceptable manufacturers shall be:

1. Alpha.

2. Okonite.

3. Belden.

4. Advance Wire and Cable.

2.02 CONNECTORS FOR CONDUCTORS

A. Connectors for branch circuits 8 AWG and smaller shall be compression type as manufactured by Burndy, Thomas & Betts, or as approved by the Owner. Twist-on type connectors are not acceptable.

B. Connectors for copper conductors larger than 8 AWG shall be power cable compression type, bolt or clamp type as manufactured by Burndy, Thomas & Betts or as approved by the Owner.

C. Connectors shall be of highly conductive and corrosion-resistant material.

D. Connectors for cable sizes 250 Kcmil and larger shall have not less than two clamping elements or compression indents.

E. Control wiring terminated on screw terminals shall be terminated with locking spade type solderless connectors, equivalent to Thomas & Betts Sta-Kon type.

F. Splices and joints, if approved, shall be insulated with material approved for the particular use, location, voltage and temperature.

G. Provide electrical insulating tape, Scotch 33 PLUS or approved equivalent, heat shrinkable insulating tubing and boots, and cable ties as required.

H. Terminations to tubular terminals shall be made using bare stripped wire.

PART 3 - EXECUTION OF WORK

3.01 WIRING METHOD

A. All wiring shall be installed in raceways unless otherwise noted.

3.02 INSTALLATION

A. Install electrical cables, wires, and connectors in compliance with NEC, latest edition.

B. For each electrical connection, provide complete assembly of materials including, but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat shrinkable insulation tubing, cable ties, solderless wirenuts, and other items and accessories as needed to complete splices and terminations.

C. Pull conductors simultaneously where more than one is being installed in same raceway. Use Polywater J pulling lubricant or equivalent UL approved food grade pulling lubricant if approved by the Owner's Representative, where necessary.

D. Use a pulling means including fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

E. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors with conductors larger than No. 10

AWG cable in individual circuits. Make terminations so there is not bare conductor at the terminal.

F. Motor connections shall use compression type solderless connectors bolted together in motor peckerhead.

G. In lighting/receptacle circuits, where pigtails are required, use crimp type connections.

H. Control wiring, power from different sources, etc., shall be routed in separate conduit systems unless otherwise noted on drawings.

I. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams.

J. Cover approved splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than the electrical insulation rating of those conductors being spliced.

K. Prepare cables and wires by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Do not cut through tapes which will remain on conductors. Do not "ring" copper conductors while stripping wire.

L. Instrumentation signal wiring below 60 VAC shall be routed separately from power, instrument power, and control wiring.

M. Special cables, interconnecting their sensing elements with their converters shall be installed in accordance with the engineering drawings or in compliance with the manufacturer's instructions. Extra precautions should be taken when pulling or shortening "equipment-furnished" cables to maintain integrity of cable as shipped.

N. When terminating signal cable for low voltage DC loops, black shall be terminated on the positive (+) terminal and white shall be terminated on the negative (-) terminal, unless otherwise noted.

O. Wire or cable shall not have any mechanical stress or strain in any raceway or at any connection.

P. Electrical signal cables from electronic instrument transmitters to receivers and to final instrument control elements shall be continuously shielded. Shields are to be grounded in accordance with the wiring detail shown on Drawings or manufacturer's wiring diagram provided with component.

Q. Where cables are run through conduit, the entry and exit shall be smooth and free from burrs. Cables must be pulled into conduit in a way that ensures there is not damage to the cable.

R. Splices shall be made only at terminals in instruments or approved equipment as indicated on the wiring detail. No intermediate splices shall be made in the raceway except as approved by the Owner'on a case-by-case basis.

3.03 FIELD QUALITY CONTROL

A. Prior to energizing, check installed wires and cables with megaohm meter to determine insulation resistance levels to assure requirements are fulfilled.

B. Prior to energizing, test wires and cables for electrical continuity and for short circuits.

C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units and re-test to demonstrate compliance at no cost to the Owner.

3.04 WIRE AND CABLE IDENTIFICATION

A. Phase identification shall be carefully maintained and shall be consistent throughout. Required order of rotation for the building shall be Phase A, Phase B, and Phase C with voltage reaching maximum value in that order. Bus bars in secondary distribution equipment, such as motor control centers, power panels, lighting panels, etc. shall be in the order A-B-C from front to back, top to bottom or left to right (vertically).

B. All wire and cable shall have identification installed at both ends.

C. All control wires shall be labeled at all terminations at both ends.

D. All spare conductors shall be so marked and labeled as to the location of their opposite ends.

E. Labels and wire marking shall be in accordance with Section 16195 - Electrical Identification.

3.05 COLOR CODING

A. Color code secondary service, feeders, and branch circuit conductors as follows or as requested by the Owner.

PHASE	240V	480V	208Y/120V	240/120V
A	Brown	Brown	Black	Black
B	Orange	Orange	Red	Red
C	Yellow	Yellow	Blue	- -
NEUT	Gray	Gray	White	White
GND	Green	Green	Green	Green

B. Conductors 8 AWG and smaller shall have factory-applied colors. Conductors larger than 8 AWG shall be given two bands of colored tape, approximately 6 inches from end of conductor. Bands shall be spaced 1 inch apart. The bands shall be at both ends of the conductor and the appropriate color per the table above.

END OF SECTION

SECTION 16130
ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide electrical boxes and fittings including, but not limited to:

1. Wall and ceiling outlet boxes.

2. Pull and junction boxes.

3. Wiring troughs.

4. Fittings and accessories necessary to make a complete system.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

2. Section 16111 - Conduit.

3. Section 16190 - Supporting Devices.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. Comply with provisions of the following codes:

1. ANSI/NEMA FB1 - Fittings and Supports for Conduit and Cable Assemblies.

2. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

3. NFPA 70 - National Electrical Code (NEC), latest edition.

4. Underwriter's Laboratories (UL) - Pertinent Standard, Approvals and Listing.

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

1.05 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.06 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

1.07 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirement information.

1.08 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for material information.

1.09 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.10 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.11 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

PART 2 - PRODUCTS AND MATERIALS

2.01 GENERAL REQUIREMENTS

A. The types of outlet, device, junction and pull boxes allowed for the various applications are as specified in this section.

B. Boxes for use with raceway systems shall not be less than 1 1/2 inch deep except where shallower boxes required by structural conditions are approved. Boxes shall not be less than 4 inch square except that 4 inch by 2 inch boxes may be used where only one raceway enters the outlet.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION REQUIREMENTS

A. Install electrical boxes and fittings as indicated in accordance with the manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

B. Provide weathertight outlets for all outdoor locations and as specified on the drawings.

C. Provide knockout closures to cap unused knockout holes where blanks have been removed.

D. Install electrical boxes in those locations that ensure ready accessibility to enclosed electrical wiring.

E. Conduit runs shall have a pullbox installed such that no run exceeds 150 feet unless approved by the Owner.

F. Do not install boxes back-to-back in walls. Provide not less than 6 inch separation.

G. Foam insulate around all wall and flush mounted boxes in wall cavity in order to maintain sound control integrity of wall insulation system.

H. Do not install aluminum products in concrete.

I. Position recessed outlet boxes accurately to allow for surface finish thickness.

J. Subsequent to installation of boxes, protect boxes from construction and debris and damage.

K. Do not drill holes in roof or ceiling panels without approval by the Owner or the Engineer.

L. After torquing, ensure that sealing grommets expand to form a watertight seal.

3.02 FITTINGS

A. Type LB and similar raceway fittings may be used at the end of conduit runs where long runs of cable do not have to be pulled through the fitting.

B. Where threaded couplings cannot be used, use concrete style tight split couplings.

C. Double steel locknuts shall be used for all metallic raceways, except that an insulating bushing shall be used for conduit 2 inches or larger.

D. Grounding type bushings shall be used for metallic raceways connected to switchboards, transformers, motor control centers and panelboards.

3.03 ELECTRICAL BOX MOUNTING HEIGHTS

A. Convenience outlets - Unfinished areas 42 inches above finished floor, finished areas 16 inches.

B. Counter outlets - 12 inches above counter surfaces.

C. Switch boxes - 42 inches above finished floor. For handicap areas, refer to ADA requirements on the drawings.

D. Motor control stations, push buttons, selector switches, starters - 60 inches above finished floor.

E. Motor disconnects at equipment shall be located after input from the Owner and the Engineer. Disconnects shall be located approximately 30 inches above finished floor with flexible conduit running to the motor head.

END OF SECTION

SECTION 16141
WIRING DEVICES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide electrical wiring devices, including, but not limited to:

1. Wall switches.

2. Receptacles.

3. Device plates and box covers.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

2. Section 16130 - Electrical Boxes and Fittings.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. Comply with provisions of the following codes.

1. NEMA WD1 - General Purpose Wiring Devices.

2. NEMA WD2 - Specific Purpose Wiring Devices.

3. NFPA 70 - National Electrical Code.

4. Underwriters Laboratories (UL) - Pertinent Standard, Approvals and Listing.

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

B. Product data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1.05 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.06 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

1.07 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.08 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for material information.

1.09 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.10 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.11 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

PART 2 - PRODUCTS AND MATERIALS

2.01 RECEPTACLES

A. Manufacturers

1. Leviton.

2. Hubbell.

3. Crouse-Hinds.

B. Provide factory fabricated wiring devices, in types, and electrical ratings for applications indicated on drawings, and which comply with NEMA WD-1. Wiring devices shall be gray in color.

C. Provide GFCI receptacles, 2 pole, 3 wire, grounding, 15 Amperes, 125 Volts. Design for side and back wiring with spring-loaded, screw-activated, pressure plate, with NEMA configuration 5-20R.

D. Provide specification grade single pole toggle switches, 20 Amperes, 120 Volts AC with mounting yoke insulated from mechanism, equipment with plaster ears, switch handle, and side-wired screw terminals as indicated on the drawings.

2.02 WALL PLATES

A. Provide cover plates which mate and match with wiring devices to which they are attached. Cover plates shall be stainless steel unless indicated otherwise.

B. Provide weatherproof cover plates which mate and match with wiring devices to which they are attached. Provide metal screws for securing plates to devices with screw heads which match finish of the plates. Plates shall be gasketed cast aluminum with weatherproof hinged gasketed device cover.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install wiring devices only in electrical boxes which are clean and free from building materials, dirt and debris.

C. Install devices plumb and level.

D. Install switches with OFF position down.

E. Install receptacles with grounding pole on bottom.

F. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

G. Connect wiring devices by wrapping conductor around screw terminal.

3.02 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Verify that each receptacle device is energized.

C. Test each receptacle device for proper polarity.

D. Test each GFCI receptacle device for proper operation.

3.03 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

END OF SECTION

SECTION 16170
GROUNDING AND BONDING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide grounding systems including, but not limited to:

1. Grounding electrodes and conductors.

2. Equipment grounding conductors.

3. Bonding.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following section contains requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. Comply with provisions of the following codes.

1. ANSI/NFPA 70 - National Electrical Code (NEC).

2. Underwriter's Laboratory (UL) - Pertinent Standard, Approvals and Listing.

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

B. Product data: Provide data for grounding electrodes and connections.

C. Test reports: Indicate overall resistance to ground and resistance to each electrode.

D. Manufacturer's instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connections.

1.05 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.06 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

1.07 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirement information.

1.08 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.09 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.10 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

B. Accurately record and document actual dimensional locations of grounding electrodes on final as built drawings.

PART 2 - PRODUCTS AND MATERIALS

2.01 ROD ELECTRODES

A. Material: Copper shall be used.

B. Diameter: 3/4 inch diameter.

C. Length: 10 feet.

2.02 MECHANICAL CONNECTORS

A. Material: Bronze, applied by exothermic methods of connection to the ground rods and major structural members.

2.03 WIRE

A. Material: Stranded copper.

B. Ground ring/grid conductor: 4/0 AWG.

C. Foundation electrodes: Size to meet NFPA 70 requirements; 2/0 AWG minimum.

D. Bonding conductors: 2 AWG unless specified otherwise.

E. Grounding electrode conductor: Size to meet NFPA 70 requirements.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION

A. Verify that final site backfill and compaction has been completed before driving rod electrodes.

B. Verify site conditions, buried utilities and line locations, etc. to eliminate possible interferences, obstructions, or damages to other materials either new or existing. Contractor shall be wholly responsible for proper notification of One Call System at least two (2) working days prior to the need to do any exploratory or other project excavation work as it pertains to this work and Contractor shall not excavate until One Call System has properly surveyed site conditions and responded accordingly.

C. Install products in accordance with manufacturer's instructions.

D. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

E. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing where indicated on drawings.

F. Provide bonding to meet regulatory requirements.

G. Equipment grounding conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

H. Weld grounding conductors to underground grounding electrodes using Cadweld system or other approved method. Coat underground welds with 15 mils of protective asphaltic paint. Underground grounding conductors shall not be spliced.

3.02 INTERFACE WITH OTHER PRODUCTS

A. Interface with other work including existing site grounding. Coordination of other work and communications regarding schedules, etc. is part of this work.

B. Verify grounding requirements, needs of all site equipment and materials, appliances, equipment installed by other contractors, equipment furnished and/or installed by the Owner, or other suppliers etc. Review the grounding requirements of each item and ground all items requiring grounding, bonding, etc. according to the NEC and according to the manufacturer's recommendations.

3.03 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the IEEE fall-of-potential method.

C. Grounding system resistance: One or more ground rods are shown on the drawings. However, additional ground rods shall be installed until resistance from the ground conductor system to ground is 5 ohms or less. Additional rods, if needed, shall be installed a minimum of 10 feet from initial ground rods.

END OF SECTION

SECTION 16175
DISCONNECT SWITCHES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide disconnect switches including, but not limited to:

1. Equipment disconnects.

2. Motor circuit disconnects.

3. Appliance disconnects.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

2. Section 16141 - Wiring Devices.

1.03 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

B. Products data pertaining to electrical characteristics and construction for each type of product specified.

C. Maintenance data for circuit and motor disconnects, for inclusion in operation and maintenance manual.

1.04 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.05 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

1.06 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

B. Provide components complying with NFPA 70, National Electrical Code (NEC) and which are listed and labeled by UL. Comply with UL Standard 98 and NEMA Standard KS1.

1.07 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.08 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.09 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

PART 2 - PRODUCTS AND MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Allen-Bradley.

2. Mennekes.

3. Square D.

4. Hubbell.

2.02 CIRCUIT AND MOTOR DISCONNECT SWITCHES

A. Provide circuit and motor disconnect switches in types, sizes, duties, features, ratings, and enclosures as indicated on the drawings. Motor and equipment disconnect switches shall have lockable handles and ground connection terminal. They shall be furnished with one (1) N.O.-N.C. 120 Volt auxiliary interlock.

B. All single phase motors shall have disconnect switches as shown on the drawings.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION

A. Provide circuit and motor disconnect switches local to every motor as indicated and where required by NEC. Comply with switch manufacturer's printed installation instructions.

3.02 FIELD QUALITY CONTROL

A. Subsequent to completion of installation of electrical disconnect switches, energize circuits and demonstrate capability and compliance with requirements. Except as otherwise indicated, do not test switches by operating them under load. However, demonstrate switch operation through several opening/closing cycles with circuit unloaded. Open each switch enclosure for inspection of interior, mechanical and electrical connections, fuse installation and for verification of type and rating of fuses installed. Correct deficiencies; then retest to demonstrate compliance. Remove and replace defective units with new units.

END OF SECTION

SECTION 16180
EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide equipment wiring systems including, but not limited to:

1. Process equipment.

2. Motors.

3. From electrical source to disconnects.

4. Grounds including earthing connections.

5. Control devices and instrumentation.

6. Control cabinets, operator stations and computer equipment.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

2. Section 16111 - Conduit

3. Section 16120 - Wires and Cables.

4. Section 16130 - Electrical Boxes and Fittings.

5. Section 16175 - Disconnect Switches.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. Comply with the following standards.

1. NEMA WD 1 - General Purpose Wiring Devices.

2. NEMA WD 5 - Specific-Purpose Wiring Devices.

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

1.05 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.06 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

B. Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than five (5) years.

C. Installer's qualifications: Firms with at least five (5) years of successful installation experience with projects utilizing electrical connections for equipment similar to that required for this project.

D. NEC compliance: Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches.

E. ANSI compliance: Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.

F. UL compliance: Comply with UL Std. 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors" including, but not limited to tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are UL-listed and labeled.

1.07 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.08 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for materials information.

1.09 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.10 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.11 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

PART 2 - PRODUCTS AND MATERIALS

2.01 MATERIALS AND MANUFACTURERS

A. General: For each electrical connection indicated, provide complete assembly of materials, including but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solderless wirenuts, and other items and accessories as needed to complete splices and termination of types indicated.

B. Cords and caps

1. Straight-blade attachment plug: NEMA WD 1.

2. Locking-blade attachment plug: NEMA WD 5.

3. Attachment plug configuration: Match receptacle configuration at outlet provided for equipment.

4. Cord construction: Oil-resistant thermoset insulated Type SOW multiconductor flexible cord with identified equipment grounding conductor, suitable for extra hard usage in damp locations.

5. Cord size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

C. Connectors and terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.

D. Electrical connection accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, wirenuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

E. Acceptable manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work included, but are not limited to, the following:

1. Appleton Electric

2. Arrow-Hart

3. Burndy

4. Ideal Industries

5. Square D

6. Thomas and Betts

PART 3 - EXECUTION OF WORK

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 PREPARATION

A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installed.

B. Coordinate with other work, including wire and cables, raceway and equipment installation, as required to properly interface installation of electrical connections for equipment.

3.03 ERECTION, INSTALLATION, APPLICATION

A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit in damp or wet locations.

C. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.

D. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.

E. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.

F. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.

G. Maintain existing electrical service and feeders to occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by Owners authorized representative. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "switching over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated.

H. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

I. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors.

J. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

K. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torqueing tools, including torque screw driver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torqueing requirements are not available, tightening connectors and terminals to comply with torqueing values contained in UL's 486A.

L. Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase and feeder number in accordance with Section 16195 Electrical Identification. Affix markers on each terminal conductor, as close as possible to the point of connection.

3.04 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION

SECTION 16190
SUPPORTING DEVICES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide supporting devices including, but not limited to:

1. Stainless steel angles.

2. Clevis hangers.

3. Riser clamps.

4. C-clamps.

5. I-beam clamps.

6. One-hole conduit straps.

7. Two-hole conduit straps.

8. Round steel rods.

9. Toggle bolts.

10. Wall and floor seals.

B. Extent of supports, anchors, sleeves, and seals shall be as required for the electrical installation and shall conform to all codes, and standards.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following section contains requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

1.03 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

1.04 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.05 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

B. Comply with NEC requirements as applicable to construction and installation of electrical supporting devices.

C. Provide electrical components which are UL listed and labeled.

D. Comply with Federal Specification FF-S-760 pertaining to retaining straps for conduit, pipe, and cable.

1.06 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.07 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for material information.

1.08 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.09 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.10 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURED SUPPORTING DEVICES

A. Provide supporting devices which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation, and as herein specified.

B. No painted materials shall be permitted to be installed in processing areas. All screws, bolts, washers, nuts, etc., shall be stainless steel. If a product is supplied with standards grade screw, bolt, washer, nut, etc., the Contractor shall be responsible for installing the stainless steel types.

C. Any welding required in the fabrication of a support must have continuous welds around all joints and ground clean. Prime and paint carbon steel materials.

D. Stainless steel stud bolts shall be welded to tubing supports for the purpose of attaching enclosures. Drilled and tapped holes are not acceptable in tubing.

E. Provide anchors of types indicated with the following construction features:

1. Lead expansion anchors: Fastening to masonry construction.

2. Toggle bolts: Springhead type, hollow wall construction.

3. Available manufacturers: Subject to compliance with requirements, manufacturers offering anchors which may be incorporated in the work include, but are not limited to, the following:

a) Abbeon Cal, Inc.

b) Ackerman Johnson Fastening Systems, Inc.

c) Elcen Metal Products Co.

d) Ideal Industries, Inc.

e) Joslyn Manufacturing and Supply Co.

f) McGraw-Edison Co.

g) Rawplug Co., Inc.

h) Star Expansion Co.

i) U.S. Expansion Bolt Co.

F. Provide factory-assembled watertight wall and floor seals of type and sizes indicated, suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.

G. Fire stop materials shall be UL listed materials manufactured by Dow, G.E., 3M, or equivalent.

H. Provide stainless steel mounting plates, brackets and hangers in processing area. Clean all welds and provide a finished work appearance.

2.02 FABRICATED SUPPORTING DEVICES

A. Pipe sleeves

1. Steel pipe: Fabricate from Schedule 40 steel pipe; remove burrs.

2. Overhead conduit support: Provide conduit support using rods threaded at each end supporting conduit with appropriate hangers.

3. Overhead conduit supports in processing area: Provide conduit support using stainless steel rods threaded at each end supporting conduit with appropriate stainless steel hangers.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION

A. Install hangers, anchors, sleeves, and seals in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of the NEC for installation of supporting devices.

B. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze-type hangers where possible. Install supports with spacings indicated and in compliance with NEC requirements.

C. All supports, anchors, sleeves, mounting channels, bolted apparatus, clamps and straps shall be caulked all around at the wall surface as required to provide a seal against water penetration behind same such that no area of contamination exists that will hold moisture, debris, or, in general, render an area to become soiled yet inaccessible for easy cleaning.

END OF SECTION

SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 WORK INLCUDED

A. Provide electrical identification including, but not limited to:

1. Labels.

2. Marking tape.

3. Warning signs.

4. Fasteners and cable ties.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

2. Section 16120 - Wires and Cables.

1.03 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

B. Submit the following information to Owner/Engineer before installation is to begin.

1. Product data for each type of product specified.

2. Schedule of identification nomenclature to be used for identification signs and labels.

1.04 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.05 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

B. Components and installation shall comply with NFPA 70, National Electrical Code.

1.06 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.07 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for materials information.

1.08 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.09 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.10 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

PART 2 - PRODUCTS AND MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. American Labelmark Co.

2. Emed Co., Inc.

3. Ideal Industries.

4. Markal Corporation.

5. National Band and Tag Co.

6. Panduit Corporation.

7. Seton Name Plate Co.

8. W. H. Brady Co.

2.02 ELECTRICAL IDENTIFICATION PRODUCTS

A. Underground line marking tape: Permanent, bright-colored continuous printed plastic tape compounded for direct burial service not less than 6 inches wide by 4 mils thick. Printed legend indicative of general type of underground line below.

B. Plasticized card stock tags: Vinyl cloth with preprinted legends/alpha-numeric to suit the application. Orange background, pressure sensitive, self-adhesive label with black lettering except as otherwise indicated.

C. Engraved plastic-laminated labels, signs, and instruction plates: Engraving stock melamine plastic laminate, 1/16 inch minimum thick for signs up to 20 square inches, or 8 inches in length, 1/8-inch-thick for larger sizes. Engraved legend in black on white face and punched for mechanical fasteners.

D. Warning and caution signs for interior use: Preprinted aluminum signs, punched for fasteners, with colors, legend and size appropriate to the location.

E. Fasteners for plastic laminated and metal signs: Self-tapping stainless steel screw or No. 10/32 stainless steel machine screws with nuts with flat and lock washers.

F. Cable ties: Fungus inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18 inch minimum width, 50 pound minimum tensile strength and suitable for a temperature range from minus 50 degrees F to 350 degrees F.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION

A. Lettering and graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

C. Sequence of work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

D. Conduit identification: Identify high-voltage feeder conduits (over 600 Volts) by words "DANGER-HIGH VOLTAGE KEEP AWAY" preprinted on pressure-sensitive, self-adhesive label, with black letters on orange background.

E. Apply equipment identification labels of engraved plastic laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text with 1/2-inch-high lettering on 1-1/2 inch high label (2 inches high where two lines are required), black lettering in white field. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment:

1. Panelboards, electrical cabinets, and enclosures.

2. Access doors and panels for concealed electrical items.

3. Motor starters.

4. Pushbutton stations.

5. Power transfer equipment.

6. Contactors.

7. Remote controlled switches.

8. Control devices.

F. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker. Panelboards shall also have voltage identified on front of panel with plasticized card stock tags.

G. Install labels at locations indicated and at location for best convenience of viewing without interference with operation or maintenance of equipment.

H. Tag all hazards with a permanent tag or sign (e.g., temperature elements with no thermowell).

END OF SECTION

SECTION 16425
SWITCHBOARDS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide switchboards including, but not limited to:

1. Main and distribution switchboards, 600 Volts and less.

2. Molded case circuit breakers.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following section contains requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. Comply with the provisions of the standards referenced herein.

1. ANSI C12 - Code for Electricity Metering.

2. ANSI C39.1 - Requirements for Electrical Analog Indicating Instruments.

3. ANSI C57.13 - Requirements for Instrument Transformers.

4. NEMA AB 1 - Molded Case Circuit Breakers.

5. NEMA KS 1 - Enclosed Switches.

6. NEMA PB 2 - Dead Front Distribution Switchboards.

7. NEMA PB 2.1 - Instructions for Safe Handling, Installation, Operation and Maintenance of Dead front switchboards Rated 600 Volts or less.

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

B. Submit required number of shop drawings, product data and instructions as follows.

1. With proposal: Three (3) copies.

2. For review/approval: Three (3) copies.

3. For record: Six (6) copies.

C. Furnish a complete list of drawings and product literature to be furnished and scheduled dates when they will be furnished.

D. Submit shop drawings indicating front and side views of enclosures with overall dimensions and shipping splits shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; switchboard instrument details;

and electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.

E. Submit product data for each component and accessory specified.

F. Submit one line, schematic and wiring diagrams indicating items furnished by supplier.

G. Show net fabrication and shipping weights.

H. Submit manufacturer's installation instructions.

I. Submit reports indicating recommended adjustments and overcurrent protective device coordination curves.

1.05 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.06 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

B. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five (5) years documented experience.

1.07 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.08 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for materials information.

B. On site storage and handling by Contractor as follows.

1. Accept products on site in factory shipping splits and verify damage.

2. Protect products from moisture and debris by storing in a clean, dry heated space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cove to protect units. Provide auxiliary heating in switchgear and transformer sections in accordance with manufacturer instructions.

1.09 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.10 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.11 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

B. Submit six (6) copies of operation and maintenance data bound in booklet; include but not limited to:

1. All shop drawings.

2. Bus tightening intervals and procedures, and overcurrent protective devices maintenance procedures.

3. Overcurrent protective device adjusting and testing instructions.

4. Spare parts data listing; source and current prices of replacement parts and supplies.

5. Recommended maintenance procedures and intervals.

C. Provide extra materials as follows:

1. Keys: Three (3) sets of each.

2. Fuses: Three (3) spare fuses of each type and rating installed.

3. Fuse Pullers: One (1) fuse puller for fuse type installed.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Square D Company.

2.02 SWITCHBOARD CONSTRUCTION AND RATINGS

A. Factory-assembled, dead front, metal-enclosed, and self-supporting switchboard assembly conforming to NEMA PB2, and complete from incoming line terminals to load-side terminations.

B. Switchboard electrical ratings and configurations as shown on the drawings.

C. Line and load terminations: Accessible from the front of the switchboard, suitable for the conductor materials used.

D. Bus material: Copper.

E. Bus connections: Bolted, accessible from the front, for maintenance. Provisions for extension.

F. Fully insulate bus bars throughout, with reduced bus spacing.

G. Provide a 1 inch x 1/4 inch copper ground bus through the length of the switchboard.

H. Enclosure shall be NEMA PB 2 Type 1 - General Purpose. Sections shall align at the front.

I. Switchboard height: NEMA PB2.

J. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

K. Pull box: Same construction as switchboard. Top and sides shall be removable.

L. Pull section: Same construction as switchboard.

M. Future provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Continuous current rating as indicated on drawings.

2.03 SWITCHING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded case circuit breakers with current limiters: NEMA AB 1; provide molded case circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.

B. Current limiting molded case circuit breakers: NEMA AB 1; provide molded case circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 rms amperes symmetrical let-through current and energy level less than permitted for same size Class RK-5 fuse.

C. Solid-state molded case circuit breakers: NEMA AB 1; provide with electronic sensing, timing and tripping circuits for adjustable current setting; ground fault trip; instantaneous trip; and adjustable short time trip.

PART 3 - EXECUTION OF WORK

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field measurements are as shown on the drawings.

C. Verify that required utilities are available, in proper location, and ready for use.

D. Beginning of installation means installer accepts conditions.

3.02 INSTALLATION

A. Install switchboard in locations shown on the drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1.

B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.

C. Install fuses in each switch.

D. Accurately record actual locations of switchboard and circuit connections.

3.03 FIELD QUALITY CONTROL

A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

B. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each. Test voltage shall be 1000 volts, and minimum acceptable value for insulation resistance in 2 megaohms.

C. Check tightness of accessible bolted bus joints using a calibrated torque wrench. Tightness shall be in accordance with manufacturer's recommended values.

D. Physically test key interlock systems to insure proper function.

3.04 ADJUSTING AND CLEANING

A. Adjust all operating mechanisms for free mechanical movement.

B. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 16461
DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide transformers including, but not limited to:

1. Dry type two winding transformers.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

2. Section 16111 - Conduit.

3. Section 16170 - Grounding and Bonding.

4. Section 16190 - Supporting Devices.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. Comply with the standards referenced herein:

1. NEMA ST 20 - Dry Type Transformers for General Applications.

2. NFPA 70 - National Electrical Code (NEC) latest edition.

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

B. Product data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

C. Test reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

D. Manufacturer's instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

E. Manufacturer's certificate: Certify that products meet or exceed specified requirements.

1.05 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.06 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

B. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

C. Furnish products listed and classified by UL as suitable for purpose specified and shown.

1.07 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.08 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for materials information.

B. Deliver transformers individually wrapped for protection and mounted on shipping skids.

C. Accept transformers on site. Inspect for damage.

D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.09 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.10 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.11 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

PART 2 - PRODUCTS AND MATERIALS

2.01 TWO-WINDING TRANSFORMERS

A. Description: NEMA ST 20, factory-assembled, air cooled dry type transformers ratings as indicated.

B. Insulation system and average winding temperature rise for rated KVA as follows.

1. 1-15 KVA: Class 185 with 115 degrees C rise.

2. 16-500 KVA: Class 220 with 150 degrees C rise.

C. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point.

D. Winding taps

1. Transformers less than 15 KVA: Two 5 percent below rated voltage, full capacity taps on primary winding.

2. Transformers 15 KVA and Larger: NEMA ST 20.

E. Sound levels: NEMA ST 20.

F. Basic impulse level: 10 KV.

G. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

H. Mounting: Suitable for floor mounting.

I. Coil conductors: Continuous windings with terminations brazed or welded.

J. Enclosure: NEMA ST 20; type ventilated. Provide lifting eyes or brackets.

K. Isolate core and coil from enclosure using vibration-absorbing mounts.

L. Nameplate: Include transformer connection data.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION

A. Verify that surfaces are suitable for installing transformer supports.

B. Provide concrete pad as shown on drawings.

C. Install products in accordance with manufacturer's instructions.

D. Set transformer plumb and level.

E. Use flexible conduit under the provisions of Section 16111 - Conduit with 2 feet minimum length for connections to transformer case. Make conduit connections to side panel of enclosure.

F. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

G. Provide seismic restraints.

H. Provide grounding and bonding in accordance with Section 16170 - Grounding and Bonding.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing shall be per manufacturer's recommendations.

B. Check for damage and tight connections prior to energizing transformer.

C. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 16470
PANELBOARDS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Panelboards rated 600 Volts and less.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

2. Section 16190 - Supporting Devices.

3. Section 16195 - Electrical Identification.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. Comply with provisions of the following codes.

1. NEMA AB 1 - Molded Case Circuit Breakers.

2. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

3. NEMA KS 1 - Enclosed Switches.

4. NEMA PB 1 - Panelboards.

5. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

6. NFPA 70 - National Electrical Code (NEC) latest edition.

7. Underwriters laboratory (UL) - Pertinent Standard, Approvals and Listing.

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

B. Shop drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

C. Manufacturer's installation instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of the panelboard.

1.05 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.06 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

B. Manufacturer: Company specializing in manufacturing panelboards with minimum three (3) years documented experience.

1.07 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

B. Conform to requirements of NFPA 70, National Electrical Code (NEC), latest edition.

C. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.08 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for materials information.

1.09 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.10 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.11 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

B. Record actual locations of the panelboards; indicate actual branch circuit arrangement.

C. Maintenance data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

PART 2 - PRODUCTS AND MATERIALS

2.01 BRANCH CIRCUIT PANELBOARDS

A. Manufacturer: Square D.

B. Lighting and appliance branch circuit panelboards: NEMA PB1, circuit breaker type.

C. Panelboard bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.

D. Minimum integrated short circuit rating: As indicated on the drawings.

E. Molded case circuit breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

F. Enclosure: NEMA PB 1, Type 1.

G. Cabinet box: 6 inches deep; 20 inches wide, or as required by manufacturer.

H. Cabinet front: Surface cabinet front with concealed trim clamps, concealed hinge, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards plumb. Provide supports in accordance with Section 16190 - Supporting Devices.

C. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

D. Provide a minimum of four (4) spare installed 20 Ampere breakers in lighting panelboards. Provide filler plates for unused spaces in panelboards.

E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

F. Provide engraved plastic nameplates under the provisions of Section 16195 - Electrical Identification.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing shall be per manufacturer's recommendations.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

C. Visual and mechanical inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

SECTION 16481
MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This specification covers the design, manufacturing, testing and delivery to the jobsite of a metal-clad, free-standing motor control center, complete with accessories and all auxiliary equipment needed to accomplish the functions required by this specification and the drawings.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following section contains requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. Comply with the standards referenced herein:

1. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.

2. UL 845 - Electric Motor Control Centers.

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

B. Submit manufacturer's data on motor control centers pertaining to electrical ratings, construction and enclosures.

1.05 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

B. Comply with NEMA Standards Pub/No. ICS-2, pertaining to testing and installation of motor control centers, and with applicable NEMA standards for fuses.

C. Comply with applicable requirements of UL Std 486A "Wire Connectors and Soldering Lugs for Use with Copper Conductors", and UL Std. 845, "Electric Motor Control Centers". Provide MCC's and ancillary equipment which are UL listed and labeled.

D. Comply with applicable requirements of IEEE Std 241 pertaining to installation of motor control centers. PB1, "Motor Control Centers", and Pub/No. PB1.1, "Instructions for Safe Installation, Operation and Maintenance of Motor Control Centers Rated 600 Volts or Less".

1.06 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.07 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for materials.

1.08 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.09 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.10 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

PART 2 - PRODUCTS AND MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering motor control centers which may be incorporated in the work include, but are not limited to, the following:

1. Square D.

2.02 ENCLOSURE

A. The motor control center shall consist of vertical sections each approximately 20 inches wide, 20 inches deep, and 90 inches high bolted together to form a straight-line, rigid, metal-clad, free standing, completely dead front, enclosed control assembly. Enclosure shall be NEMA 12, indoor, general purpose type. Power shall be distributed by continuous copper bus bars. The manufacturer shall include removable lifting angles to facilitate field installation. Compartments within each vertical section are based upon approximately 12 inches high modules, so as to allow the installation of a maximum of six (6) NEMA size 1 combination starters in each section.

2.03 WIRING

A. Control center wiring shall conform to the requirements of NEMA Class I, Type B, with unit terminal boards for both load and control connections provided for each Size 3 and smaller starter. Standard layout sketches shall be provided and unit wiring diagrams shall be located inside each unit door.

2.04 VOLTAGE

A. Motor control center shall be suitable for 480 Volts, 3 phase, 3 wire service.

2.05 BUS BARS

A. The main horizontal bus shall be 3 phase, 3 wire tin-plated copper rated at 600 Amps continuous and shall extend the full length of the motor control center. Bus ratings shall be based on 50-degree C maximum temperature rise in a 40 degree C ambient. Provisions shall be provided for adding additional sections on to either end of the motor control center.

B. Each section shall be provided with a vertical bus for distributing power from the main bus to the individual starter units. This bus shall be of the same material as the main bus, and shall be rated at 300 Amps continuous. The vertical bus shall be connected directly to the horizontal bus stack without the use of risers or other intervening connectors. When a back-to-back unit arrangement is utilized, separate vertical bus shall be provided for both the front and rear units.

C. A copper ground bus shall be provided that runs the entire length of the motor control center. The ground bus shall be 1/4 inch x 1 inch and be rated for 600 Amps. A compression lug shall be provided at each end of the motor control center for a 4/0-250 KCMIL ground cable.

D. All bus work shall be braced to withstand 65,000 RMS amperes minimum short circuit current at rated voltage.

2.06 WIREWAY

A. Each vertical section of the motor control center shall be provided with a minimum 12 inches high top-mounted, horizontal wire way with front removable access cover and a minimum 6 inches high horizontal wire way at the bottom of each section. In addition, each structure shall be provided with adequately sized vertical wire ways. Insulating barriers between compartments shall be easily removable to facilitate installation of outgoing wiring.

2.07 STARTERS

A. The quantity and NEMA size of starter units shall be as shown on the drawings. All starter units shall be full voltage non-reversing with fused disconnects, NEMA motor starter, and overload element, 480 Volts, 3 pole with 120 Volt control transformers and 120 Volt control circuits, with all components and wiring readily accessible for ease of maintenance. Fused disconnect and starter combined short circuit rating shall be 65,000 amperes minimum. Starter unit shall be as shown on the drawings or described in the motor control schedules. Minimum starter size shall be size 1. Each unit shall have a Hand-Off-Auto switch and pilot lamp.

B. Each starter unit shall be completely isolated from others in the vertical structure by heavy gauge sheet steel enclosures. Connection of starters to vertical buses shall be by means of heavy duty "stab-on", insulated connectors.

C. Guide rails, or equivalent means, shall be provided within the structure for accurate support and alignment of the units during removal or replacement.

D. Starters shall be designed so that starters of the same size and type can be interchanged with similar units, without changing doors. Starters shall have provision for the field installation of one overload relay in each of the three phase legs. Overload heater elements shall be furnished.

E. Starters shall have hinged door with the external operating handle provided with a padlock type lockout to lock both the disconnect and door. When the operator is not padlocked, the door interlock shall be released with a screwdriver or other tool even with power on. Otherwise, the door interlock shall allow opening the door only when disconnect is in the "off" position.

F. Starters shall be operated from external controls or controllers.

1. When future starter spaces have been called for on drawings, they shall be supplied complete with guide rails, vertical bus bars, plug-in connections and blank cover plates ready for installation of starter units with a minimum amount of field labor.

2. Overload relays shall be of the melting alloy, manual reset type. The reset button shall be located on the door of each unit.

3. Two (2) N.O. and Two (2) N.C. auxiliary contacts shall be provided for each starter. These contacts shall be prewired to the terminal strips.

2.08 CONTROLS

A. Auxiliary control relays, interlocks and timers called for on the control drawings shall be located in the respective control transformer compartment.

2.09 CIRCUIT BREAKERS

A. Circuit breakers installed for miscellaneous feeders shall have 65,000 amps RMS interrupting capacity.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION

A. Install motor control centers as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices; complying with applicable requirements of NEC, NEMA's Std Pub/No. ICS-2, and NECA's "Standard of Installation". Motor control centers shall be installed on 4 inch concrete pads.

B. Furnish and install ambient compensated motor overload heater elements, in motor control center units, size heaters based upon actual motor nameplate data.

3.02 FIELD QUALITY CONTROL

A. Prior to energization of electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.

B. Prior to energization of motor control centers, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled in accordance with Section 16010 - General Electrical Requirements.

C. Prior to energization, check motor control centers for electrical continuity of circuits, and for short circuits.

3.03 ADJUSTING AND CLEANING

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finishes.

3.04 DEMONSTRATION

A. Subsequent to wire and cable hookups, energize motor control centers and demonstrate to the Owner that equipment functions in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

SECTION 16510
INTERIOR LUMINAIRES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide interior luminaires including, but not limited to:

1. Fixtures.

2. Lamps.

3. Ballasts.

4. Accessories.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

2. Section 16525 - Emergency Lighting.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. American National Standards Institutes (ANSI) standards.

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

B. Shop drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product data: Submit catalog cut, dimensions, ratings, and performance data.

1.05 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site conditions information.

B. Verify field measurements prior to fabrication.

1.06 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

B. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

1.07 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.08 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for materials information.

1.09 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.10 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.11 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

B. Provide two (2) of each plastic lens type.

C. Provide one (1) replacement lamps for each lamp installed.

D. Provide two (2) of each ballast type.

PART 2 - PRODUCTS AND MATERIALS

2.01 INTERIOR LUMINAIRES

A. Product description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled on the drawings and as necessary to provide a complete unit.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION

A. Support luminaires larger than 2 x 4 foot size independent of ceiling framing.

B. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

C. Install suspended luminaires at the height as indicated on the drawings.

D. Install wall-mounted luminaires at the height as indicated on the drawings.

E. Install accessories furnished with each luminaire.

F. Connect luminaires to branch circuit outlets.

G. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

H. Install specified lamps in each luminaire.

I. Ground and bond interior luminaires under the provisions of Section 16170 - Grounding and Bonding.

3.02 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.03 ADJUSTING

A. Aim and adjust luminaires as required.

3.04 CLEANING

A. Remove dirt and debris from enclosures.

B. Clean photometric control surfaces as recommended by manufacturer.

C. Clean finishes and touch up damage.

3.05 PROTECTION OF FINISHED WORK

A. Relamp luminaires that have failed lamps at substantial completion.

END OF SECTION

SECTION 16520
EXTERIOR LUMINAIRES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide exterior lighting including, but not limited to:

1. Luminaires

2. Accessories.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following section contains requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. American National Standards Institutes (ANSI) standards.

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

B. Shop drawings: Indicate dimensions and components for each luminaire which is not a standard product of the manufacturer.

C. Product data: Submit dimensions, ratings, and performance data.

1.05 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.06 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

1.07 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.08 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

B. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

1.09 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for material information.

1.10 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.11 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.12 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

B. Provide two (2) of each lamp installed.

C. Provide one (1) gallon of touch-up paint for each different painted finish and color.

D. Provide two (2) ballasts of each lamp type installed.

PART 2 - PRODUCTS AND MATERIALS

2.01 LUMINAIRES

A. Product description: Complete exterior luminaire assemblies, with features, options, and accessories as scheduled.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION

A. Install luminaires and lamps as indicated on the drawings.

3.02 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for improper connections and operation.

B. Measure illumination levels to verify conformance with performance requirements.

C. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.03 ADJUSTING

A. Aim and adjust luminaries to provide illumination levels and distribution as directed.

3.04 CLEANING

A. Clean photometric control surfaces as recommended by manufacturer.

B. Clean finishes and touch up damage.

3.05 PROTECTION OF FINISHED WORK

A. Relamp luminaries which have failed lamps at substantial completion.

END OF SECTION

SECTION 16525
EMERGENCY LIGHTING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide emergency lighting including, but not limited to:

1. Lighting units.

2. Exit signs.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

2. Section 16510 - Interior Luminaires.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. National Electrical Manufacturers Association (NEMA) WD 6 - Wiring Devices-Dimensional Requirements.

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

B. Product data: Submit dimensions, ratings, and performance data.

1.05 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.06 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

B. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

1.07 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.08 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for materials information.

1.09 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.10 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.11 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

B. Provide one (1) replacement lamp for each lamp installed.

C. Provide one (1) replacement battery for each battery type and size.

PART 2 - PRODUCTS AND MATERIALS

2.01 EMERGENCY LIGHTING UNITS

A. Product description: As specified on the drawings.

2.02 EXIT SIGNS

A. Product description: As specified on the drawings.

PART 3 - EXECUTION OF WORK

3.01 INSTALLATION

A. Install suspended exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend sign at indicated height.

B. Install surface mounted emergency lighting units and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

C. Install wall mounted emergency lighting units and exit signs at height as indicated or as scheduled.

D. Install accessories furnished with each emergency lighting unit and exit sign.

E. Connect emergency lighting units and exit signs to branch circuit outlets provided under Section 16130 - Electrical Boxes and Fittings as indicated.

F. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within unit.

G. Install specified lamps in each emergency lighting unit and exit sign.

H. Ground and bond emergency lighting units and exit signs under the provisions of Section 16170 - Grounding and Bonding.

3.02 FIELD QUALITY CONTROL

A. Operate each unit after installation and connection. Inspect for proper connection and operation.

3.03 ADJUSTING

A. Aim and adjust lamp fixtures as indicated on the drawings and as required.

B. Position exit sign directional arrows as indicated.

3.04 PROTECTION OF FINISHED WORK

A. Relamp emergency lighting units and exit signs that have failed lamps at substantial completion.

END OF SECTION

SECTION 16900
CONTROL PANELS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide control panels including, but not limited to:

1. Control panels (cabinets).

2. Operator control stations.

3. Operator consoles.

B. Panels shall be completely designed, shop fabricated, assembled, wired, programmed, calibrated, configured and tested ready for field installation and connection of field components and electrical circuits of the given system.

1.02 RELATED SECTIONS AND DOCUMENTS

A. The following sections contain requirements that relate to this section.

1. Section 16010 - General Electrical Requirements.

2. Section 16120 - Wires and Cables.

3. Section 16160 - Cabinets and Enclosures.

4. Section 16175 - Disconnect Switches.

5. Section 16195 - Electrical Identification.

1.03 REFERENCES (Latest issue shall apply unless otherwise noted)

A. Comply with the standards referenced herein.

1. NFPA 70 - National Electrical Code.

2. State and Local Electrical Codes.

3. Applicable sections and standards of UL, NEMA, ANSI, IEEE, ISA, FDA and 3A

1.04 SUBMITTALS FOR REVIEW

A. Refer to Section 16010 - General Electrical Requirements for submittal information.

B. Furnish a complete list of drawings and product literature to be furnished and scheduled dates when they will be furnished.

C. Submit shop drawings indicating front and side views of enclosures with overall dimensions and shipping splits shown; conduit entrance locations and requirements; nameplate legends; comprehensive description of the control panels to be furnished. Information shall be included which details the construction of panel framework, base, mounting, front and interior layout, internal support, sheet metal, and protective coating. Drawings shall provide details of panel

dimensions, components, assembly, latching, materials, and identification of all components used in the assembly.

D. Submit product data for each component and accessory specified.

E. Submit one line, three line and control schematic and wiring diagrams clearly indicating items furnished, installed and wired, furnished and installed or furnished only by supplier.

F. Submit electrical power and air supply requirements.

G. Show weights - net fabrication and shipping.

H. Submit manufacturer's installation instructions.

I. Submit reports indicating recommended adjustments, calibration and configuration of devices.

J. Submit statement with proposal that equipment offered is in strict compliance with the specifications and referenced standards.

K. Submit a complete list of exceptions with proposal.

1.05 SITE CONDITIONS

A. Refer to Section 16010 - General Electrical Requirements for site condition information.

1.06 QUALITY ASSURANCE

A. Refer to Section 16010 - General Electrical Requirements for quality assurance information.

1.07 REGULATORY REQUIREMENTS

A. Refer to Section 16010 - General Electrical Requirements for regulatory requirements information.

1.08 MATERIAL DELIVERY, HANDLING, STORAGE AND PROTECTION

A. Refer to Section 16010 - General Electrical Requirements for materials information.

B. Provide all bracing, crating and other facilities required to insure safe shipment.

C. Before packaging, all equipment shall be clean and dry.

D. Open tubing and piping shall be suitably capped.

E. Removable and loose components shall be securely fastened in place. Plug-in chassis of instruments shall be adequately protected from damage and shipped separately.

F. Each separate box, crate or other container of each shipment shall be durably marked and have suitable tags attached showing equipment item number and purchase order number for purposes of identification upon receipt at the job site.

1.09 COORDINATION

A. Refer to Section 16010 - General Electrical Requirements for coordination information.

1.10 WARRANTY

A. Refer to Section 16010 - General Electrical Requirements for warranty information.

1.11 PROJECT CLOSEOUT

A. Refer to Section 16010 - General Electrical Requirements for project closeout information.

B. Submit six (6) copies of operation and maintenance data bound in booklet; include but not limited to:

1. All shop drawings properly checked and approved.

2. Device adjusting, calibration, configuration and testing instructions.

3. Product data for each component.

4. Spare parts data listing; include source and current prices of replacement parts and supplies.

5. Recommended maintenance procedures and intervals.

PART 2 - PRODUCTS AND MATERIALS

2.01 GENERAL

A. All control panels furnished shall be complete with all front panel mounted instruments, all internal components, wiring, and all accessories and hardware necessary to perform integrated control functions in accordance with the project requirements, drawings and specifications.

B. The applicable codes and standards shall be followed in the design and construction of the control panels. Commonly available hardware shall be used. There shall be no glass components of any kind.

C. The design and layout shall allow for sufficient heat dissipation for the enclosed equipment. The temperature rise of the control panel interiors shall not exceed the lowest (high) operating temperature limits of the components used as specified by the component manufacturer. Enclosure cooling means shall be designed and installed as required. Ambient temperatures will range from 60 to 105 degrees F.

D. Large control panels shall be free standing, floor mounted to allow easy access to operator devices on the front of the panels.

E. All control panel enclosures shall be NEMA rated. Enclosures intended for mounting outdoors and in the areas specified as Corrosive, Process Area, Process Control rooms shall be NEMA 4X Stainless Steel. Enclosures intended for mounting in such areas as Utility Service, Warehouse, Storage, Maintenance, etc. shall be NEMA 12. Enclosure doors shall be equipped with the provisions for installation of padlocks.

F. Ease of use and maintenance is of primary concern. The vendor shall provide an equipment arrangement which allows easy and rapid access to all operator control devices, logical grouping of related devices, accurate identification, pleasant appearance as well as easy servicing and replacement of components.

2.02 ENCLOSURES AND SUB-PANELS

A. Unless otherwise specified, all control panels shall be fabricated from minimum 12 gauge steel or stainless steel. The enclosure seams shall be continuously welded and ground smooth and

clean. All cut-outs shall be located as required per specific application and as required per design drawings. Cutting torches or other flame processing devices shall not be used to make openings. Control panels shall have square corners. All sharp corners and edges shall be smoothed.

B. All doors shall be solid except for properly sized equipment cutouts or holes. Print pockets shall be provided.

C. Latches or suitable clamps shall be provided on the doors in accordance with the NEMA rating for the enclosure.

D. There shall be a rolled lip around each door and around all sides of the enclosure openings to prevent dirt and liquid from falling into the enclosure when the doors are opened.

E. Panel and door stiffeners, as well as internal bracing, shall be provided as needed to ensure adequate rigidity and support for internal equipment.

F. All control panels with a dimension that exceeds 24 inches shall include 2-inch diameter removable lifting lugs on top. Internal bracing shall be provided around the bolt holes.

G. After fabrication has been completed, the top, bottom, sides, supports, including all cutouts, punching, and drilling shall be finished smooth. There shall be no scratches, dents, or any other blemishes on the cabinet, panel, or mounting feet.

H. After fabrication of carbon steel panels, all sides and supports, internal and external, shall be chemically cleaned and phosphatized prior to the application of high quality rust-inhibiting primer. Carbon steel panels shall be painted with one coat of primer and two top coats, minimum.

I. Top coats shall be manufacturer's standard color. Finish coats shall be a high-quality polyurethane enamel. The outside finish shall be semi-gloss and textured. All coatings shall be compatible.

J. The interior of all control panels, including sub-panels and supports, shall be painted with a high-gloss white enamel. A total of two quarts of each type and color of paint shall be provided for touch-up after installation.

K. Finish for stainless steel panels shall be 150 grit.

2.03 NAMEPLATES AND EQUIPMENT MARKING

A. All equipment and components shall be legibly and permanently identified by tag numbers, names functional designations and as shown on the design drawings. Engraved nameplates shall be employed. Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letter and numbers.

B. Nameplates shall be furnished and installed by the panel vendor and shall be 1/16 inch, three layer (white-black-white) lamicoid material. All nameplates shall be engraved and shall have approx. 30 degrees bevel on all edges, exposing the black core on all perimeters.

C. Lamicoid nameplates shall be cemented firmly to the panel face with 3M Co. tape, catalog No. Q-12 x 60 - No. 465 adhesive and stainless steel drive screws.

D. Each control panel shall have its designation and tag name/number displayed on an external nameplate.

E. All nameplate designations shall be given on the design drawings or in a nameplate schedule.

F. Nomenclature shall be all capitals with 3/16-inch minimum height except nameplates for panel boards and similar cabinets which shall be 1/2 inch minimum height.

G. All panel and door mounted devices such as selector switches, instruments, power supplies, solenoid valves, etc., shall be labeled in accordance with the drawings using nameplates on the interior of the panels.

H. Since dangerous levels of voltage may be present when the panels are opened, all control panels shall have warning labels affixed both inside and outside the door.

2.04 WIRE, CABLE AND WIRING

A. Control panels shall be shop wired and tested. All devices, equipment and components shall be wired to terminal blocks where field connections or door connections are expected in accordance with the drawings.

B. All power and control wire shall be single conductor stranded copper, 600 Volt insulation type MTW and shall be suitable for a maximum operating temperature of 90 degrees C. The wire shall have size, grade of insulation, voltage rating and manufacturer's name permanently marked on the outer covering at regular intervals.

C. All wiring and circuit overcurrent protection shall be sized for the specific equipment and/or circuit power requirements. Minimum wire size shall be as follows:

1. Power circuits - No. 12 AWG

2. Control circuits - No. 14 AWG

3. Programmable controller module wiring - No. 16 AWG

4. Ground - No. 12 AWG

5. Wiring smaller than No. 14 AWG will be permitted only where necessary for connection to electronic components and equipment. Where such connections are determined to be required, the rating of the overcurrent protection device shall not exceed the value given below:

Wire Size	Overcurrent Protect Device Rating (Maximum)
16 AWG	10 Amps
18 AWG	8 Amps
20 AWG	6 Amps
22 AWG	3 Amps

D. All low-level signal (65 volts or less), communication and other specialty cables shall be shielded as specified in Section 16120 - Wires and Cables. Color coding for control system wiring shall be as follows:

Item	Color
Line	Black
Neutral	White
Ground	Green
A.C. Control	Red
D.C. Control	Blue
Foreign AC Voltage	Yellow
2/C shielded signal cable	White or Red = positive Black = negative

E. All wiring between components within the enclosure shall be grouped and routed through the rigid, non-flammable white (or gray) vinyl plastic wire duct. The wire duct fill shall not exceed 50 percent of the cross-sectional area. Wire duct shall be furnished and installed in all panels. The duct shall be fabricated from PVC with slotted side walls and snap-on covers.

F. All wires not routed through wire duct (i.e. wire groups connecting sub-panel to door mounted components) shall be neatly grouped and securely tied with nylon tie wraps in a bundle. Tie wraps shall be placed at intervals not exceeding three (3) inches. Provide adequate slack to accommodate door swing; provide supports from the sub-panel, enclosure and framework using weld studs and suitable plastic clamps.

G. Low-level signal wires and cables shall be routed separately from power and control cables. Terminal blocks for low-level signals shall be grouped together.

H. All wires for external connections shall be brought out to terminal blocks for field connections. The exceptions shall be thermocouple leads, coaxial cable, data highway cable, etc., which shall be direct-connected to the instruments.

I. Terminal blocks shall be supplied for all connections to field wiring. Terminal blocks shall be modular, channel-mounted, tubular pressure screw connectors, rated 600 or 300 Volts as required by cable insulation. Wiring to the terminals shall be made on one side of the strip and shall be limited to two connections per terminal. All terminals strip arrangements shall include separation of voltage/signal levels (high-level and low-level). There shall be a minimum of 20 percent spare quantity of mounted terminal blocks in each control panel. All terminal blocks shall be mounted inside the enclosure. The terminal blocks shall have all terminals clearly marked. The identification of each terminal point shall match the wire tag connected to that point. Terminal blocks shall be suitably grouped in numerical and alphabetical order.

J. The terminal blocks shall be listed in the Underwriters' Laboratories Component Recognition program.

K. Use screw type terminal strips for connections to the devices equipped with leads. Where screw-type terminal strips are used on system components, wiring shall use crimp-type insulated spade terminals and shall be limited to two connections per terminal.

L. Splicing of wires inside the control panels is not be allowed.

M. Any cable connectors supplied separately shall include complete wiring instructions with the connector. All screws and bolts shall be securely fastened. All solder points shall be insulated at the connection. All terminal plug-in connectors shall be identified and keyed to prevent improper connection. All wiring connectors internal to the panels shall be tightly secured to their mating sockets.

N. Equipment with designated ground connections shall be connected to the ground bar using No. 12 AWG insulated wire, green color. Shields of shielded cables shall be grounded at one end, the power source end only.

O. All wiring shall be permanently tagged or marked at both ends with approved wire markers. Tags shall consist of wire numbers that correspond to the control schematics and wiring diagrams. All wire shall be identified by means of self-sticking "perma-code" wire markers as manufactured by W.H. Brady Company, or equivalent.

P. All PLC I/O modules (including spare) shall be shop wired to the terminal strip within the control panel.

Q. All terminal blocks and equipment test points must be easily accessible while the equipment is in operation.

2.05 CONTROL POWER

A. Circuit breakers shall be provided within the enclosure to disconnect control power to the system. A separate circuit breaker(s) shall be provided to disconnect the power from the miscellaneous circuits such as DC power supplies, etc.

B. The arrangement of the circuit breakers and the resultant control power distribution shall be as required for an operable system, subject to the approval of the Owner's Authorized Representative. An outside, 120 Volt, 60Hz, single phase power can be provided to control panel.

C. Power to each discrete input or discrete output module shall be routed through a separate, fused block.

D. Provide a separate fused block for power circuit to each instrument. This shall include transmitter power supply. A separate fused block shall be provided for each instrument, transmitter, etc. regardless of voltage level (i.e.: 24VDC).

E. Provide properly sized control circuit fuses. Glass fuses are NOT permitted.

F. Interior illumination shall be furnished by means of a 120V, single phase, 60-Hertz fluorescent-type lighting fixture, mounted from the enclosed overhead in all free-standing control cabinets. Fixture shall be controlled by a 20 Amp, 120V switch. Provide lamp with the protective plastic shield over entire length.

G. Provide minimum of one (1) grounding type duplex convenience receptacle, 15 Amp, 120V, Receptacle shall be fed from a separate circuit breaker. Mount receptacle in an easily accessible location in the interior, near the bottom of the enclosure.

PART 3 - EXECUTION OF WORK

3.01 TESTING AND INSPECTION

A. All work done and all materials furnished are subject to testing and inspection by the Owner's Project Representative to determine if they conform to such tolerances, dimensions, assembly, and wiring in compliance with the terms of the Contract.

B. These inspections and tests do not relieve the vendor from full compliance with contract requirements nor do they relieve the vendor from any of the responsibility for the work assigned to the vendor by the Contract.

C. All electrical control equipment, all interlock and sequential control systems, and all instrument circuiting pre-wired or pneumatically connected by vendor shall be checked for correct and tight connections and shall be given a complete functional test, checking all intended modes and sequences of operation of all switches, relays, contactors, circuit breakers, indicting lights, Programmable Logic Controllers, Man Machine Interface systems, meters, solenoid valves, etc., shall be checked in a manner to prove their proper functioning.

D. A test shall be made on the complete pneumatic system to assure connections are properly made and free of leaks or obstructions. This test shall be per the requirements and recommendation of ISA-RP 7.1. Where possible, functional tests shall be made, pressure switches set, gauges and instruments calibrated. Any air used for these purposes shall be dry, clean and oil free.

E. All electrical components shall be tested for proper operation at the design voltage and frequency.

F. All 600 Volt insulation cables wiring shall be checked for grounds, shorts and continuity.

G. 300 Volt insulation instrumentation cable shall be tested for continuity.

H. Coax and specialty cables shall be checked for continuity plus any further tests shall be conducted as recommended by the manufacturer of the equipment being served by the cable.

I. No waiver is hereby made or implied to any other tests the vendor would normally make to this type of equipment.

END OF SECTION