

**OLD NORWICH
SEWER PUMP STATION UPGRADES
BID NO. 23-126**

**WATERFORD UTILITY COMMISSION
WATERFORD, CONNECTICUT**

**BIDDING/CONTRACT DOCUMENTS
AND TECHNICAL SPECIFICATIONS**

JUNE 2023

21490

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FOR
OLD NORWICH
SEWER PUMP STATION UPGRADES
BID NO. 23-126

JUNE 2023



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Bid#23-126
TOWN OF WATERFORD, CONNECTICUT

TOWN OF WATERFORD, CONNECTICUT
(Owner)

Sealed bids for Bid#23-126 Old Norwich Road Sewer Pump Station Upgrades will be received by the Purchasing Agent of the Town of Waterford at the Waterford Town Hall, 15 Rope Ferry Road, Waterford, CT 06385 until 11:00 a.m., prevailing time, on August 10, 2023, and then at said office publicly opened and read aloud. Bids must be enclosed in a sealed envelope and designated as bid for **“Bid #23-126 Old Norwich Road Sewer Pump Station Upgrades.”**

Any bid may be withdrawn prior to the above scheduled time for opening of bids. Any bid received after the time and date specified will be returned unopened.

Contract documents, including Plans and Specifications, may be downloaded from the following locations at no cost. The Town will not provide printed bid documents or pay for any printing costs associated with the bid documents.

<https://www.waterfordct.org/Bids.aspx?CatID=19>

A **Non-mandatory walk-through** of the pump stations is scheduled for **10:00 A.M on Tuesday July 25, 2023**, starting at the Old Norwich Road Pump Station (38 Old Norwich Road).

Each bidder is responsible for checking these websites to determine if any addenda has been issued to the Information for Bidders and/or Contract Documents, and if so, to complete its response in accordance with the Information for Bidders and/or Contract Documents as may have been modified by any such addenda.

The contractor who is selected to perform this State project must comply with CONN. GEN. STAT. §§ 4a-60, 4a-60a, 4a-60g, and 46a-68b through 46a-68f, inclusive, as amended by June 2015 Special Session Public Act 15-5.

State law requires a minimum of twenty-five (25%) percent of the state-funded portion of the contract for award to subcontractors holding current certification from the Connecticut Department of Administrative Services (“DAS”) under the provisions of CONN. GEN. STAT. § 4a-60g. (25% of the work with DAS certified Small and Minority Owned businesses and 25% of that work with DAS certified Minority, Women and/or Disabled owned businesses.) The contractor must demonstrate good faith effort to meet the 25% set-aside goals.

For municipal public works contracts and quasi-public agency projects, the contractor must file a written or electronic non-discrimination certification with the Commission on Human Rights and Opportunities.

Forms can be found at:

http://www.ct.gov/opm/cwp/view.asp?a=2982&q=390928&opmNav_GID=1806

The Town of Waterford reserves the right to waive any formalities or to reject any or all bids.

Each bidder must deposit, with his bid, security in the form of bid bond or certified check subject to the conditions provided in the Information for Bidders.

No bidder may withdraw his bid within 90 days after the actual date of the opening thereof.

Brandishea Moses
Purchasing Agent
Town of Waterford, Connecticut

The Town of Waterford is an Equal Opportunity/Affirmative Action Employer.

INFORMATION FOR BIDDERS

1. Sealed Bids

Sealed bids for Bid#23-126 Old Norwich Road Sewer Pump Station Upgrades will be received by the Purchasing Agent of the Town of Waterford at the 15 Rope Ferry Road, Waterford, CT until 11:00 a.m. prevailing time on August 10, 2023, and then at said office publicly opened and read aloud. Bids must be enclosed in a sealed envelope and designated as bid for **“Bid#23-126 Old Norwich Road Sewer Pump Station Upgrades.”**

2. Method of Award

The Town of Waterford intends to award the contract to the lowest responsible bidder. The Town reserves the right to reject any and all bids and to award each contract to the bidder who is most responsive to the interests of the Town.

If the lowest bid submitted by a responsible bidder does not exceed the amount of funds made available by the State and Federal Agencies, the contract will be awarded on the basis of base bid. If such bid exceeds such amount, the Owner may reject all bids or award the contract on the basis of the base bid combined with such deductible alternates applied in numerical order in which they are listed in the Form of Bid that produces a net amount which is within the available funds. (Refer to Bid Forms for additional information.)

3. Bid Schedule

Bids must be made on these forms and returned intact. Bidders will state both in writing and in figures, in ink or typewritten, the proposed price for each separate item of the work called for in the bid schedule, by which prices will be compared. If any price is omitted, the blank shall be filled with the highest price named by any bidder for that item or the bid may be rejected. Alterations and erasures must be initialed by the signer.

4. Arithmetic Discrepancies

A. For the purpose of initial evaluation of bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the bidding schedule as submitted by bidders:

1. Obviously misplaced decimal points will be corrected.
2. In case of discrepancy between unit price and extended price, the unit price will govern.
3. Apparent errors in extension of unit prices will be corrected.

4. Apparent errors in addition of lump sum and extended prices will be corrected.

B. For the purpose of bid evaluation, the Town will proceed on the assumption that the bidder intends his bid to be evaluated on the basis of the unit prices, extensions, and totals arrived at by resolution of arithmetic discrepancies as provided above and the bid will be so reflected on the abstract of bids.

5. Bid Security

If the total amount of the bid submitted exceeds \$50,000, or if the bid contains any add alternates and the combination of the base bid plus all add alternates exceeds \$50,000, then the bid must be accompanied by a CERTIFIED CHECK or a BID BOND, signed by a responsible Surety, in the amount of 10% of the total amount of the tendered bid and made payable to the order of the Town of Waterford. All bid checks or bonds, except those of the lower three (3) bidders will be returned within ten (10) days of the opening of bids. Those of the lower three (3) bidders will be retained by the Town of Waterford until one of the lower three (3) bidders signs the contract or until all bids are rejected; however, in no case will the bid check or bond be retained for more than 90 days unless forfeited as hereinafter stipulated. No bidder may withdraw his bid within 90 days after the actual date of the opening thereof.

Should there be reasons why the CONTRACT cannot be awarded within the specified period, the time may be extended by mutual agreement between the OWNER and the BIDDER.

If the total amount of the bid submitted is \$50,000 or less, then no bid security is required.

The Bid Bond and Surety's Letter of Intent must be provided by a Surety Company that meets all of the following qualifications as of the date of bid.

- A. Licensed to do business in the State of Connecticut
- B. Listed on the current U. S. Treasury "T" List
- C. Rate A- or better by A. M. Best

6. Qualifications of BIDDER

The OWNER may make such investigations as it deems necessary to determine the ability of the BIDDER to perform the work, and the BIDDER shall furnish to the OWNER all such information and data for this purpose as the OWNER may request. The OWNER reserves the right to reject any bid if the evidence submitted by, or investigation of, such BIDDER fails to satisfy the OWNER that such BIDDER is properly qualified to carry out the obligations of the CONTRACT and to complete the work contemplated therein. Conditional bids shall not be accepted.

Any CONTRACTOR, who is in litigation or arbitration with the Town at the time of the bid opening, or prior to the execution of the CONTRACT, may be considered an unacceptable BIDDER and may be disqualified.

7. Identity of SUB-CONTRACTORS

If any portion of the work is to be performed by persons or entities not considered to be part of the bidder's own forces, the successful bidder shall, upon notification of the award of a contract, furnish a written list of such other persons or entities and a description of the work to be performed by them. If requested by the Owner, the successful bidder shall be required to establish, to the satisfaction of the Owner, the reliability and responsibility of such Sub-Contractors.

8. Bonds

A. **Performance Bond**

If the total bid price for the project exceeds **\$50,000**, or if the bid contains any alternates and the combination of the base bid plus all Town accepted alternates exceeds \$50,000, then either of the following is required:

1. The Contractor shall furnish a bond covering faithful performance of the Contract. Surety shall be qualified to do business in the State of Connecticut, listed on the current U. S. Treasury "T" list, and rated "A-" or better by A. M. Best. The cost of the bond premium shall be included in the Contract Sum. The amount of the bond shall be equal to 100 percent of the Contract Sum.

OR

2. In lieu of a Performance Bond, a security in a form acceptable to the Town (for example, letter of credit or an assigned passbook) in the amount of 100% of the Contract may be substituted.

The Contractor shall deliver the required security to the Owner on the date the agreement is entered into.

The Contractor shall require the attorney-in-fact, who executes the required bond on behalf of the surety, to affix thereto a certified and current copy of the power-of-attorney.

In the case where added alternates are part of the bid, and where acceptance of any alternates would cause the Contract Sum to exceed the \$50,000 threshold, then the price of the alternate shall include the cost of the required bond or security.

B. Payment Bond

If the total bid price for the project exceeds **\$100,000**, or if the bid contains any alternates and the combination of the base bid plus all Town accepted alternates exceeds \$100,000, then either of the following is required:

1. The Contractor shall furnish a bond covering payment of obligations arising under the terms of the Contract. Surety shall be qualified to do business in the State of Connecticut, listed on the current U.S. Treasury "T" list, and rated "A- "or better by A.M. Best. The cost of the bond premium shall be included in the Contract Sum. The amount of the bond shall be equal to 100 percent of the Contract Sum.

OR

2. In lieu of a Payment Bond, a security in a form acceptable to the Town (for example, a letter of credit or an assigned passbook) in the amount of 100% of the Contract may be substituted.

The Contractor shall deliver the required security to the Owner on the date the Agreement is entered into.

The Contractor shall require the attorney-in-fact, who executes the required bond on behalf of the surety, to affix thereto a certified copy of the power-of-attorney.

In the case where added alternates are part of the bid, and where acceptance of any alternates would cause the Contract Sum to exceed the \$100,000 threshold, then the price of the alternate shall include the cost of the required bond or security.

If the total bid (or base bid plus alternates) for the project is \$100,000 or less, then in lieu of providing any security listed in Section 8.B, the Contractor can elect to substitute the following:

Provide certified lien waivers from each supplier and sub-contractor affirming that they have been paid for work and materials for which previous payment applications were issued by the Owner and payments received by the Contractor.

9. Non-Resident Contractor Guarantee Bonds

A Non-Resident Contractor is required to post a Guarantee Bond (for AU766) or Cash Bond (form AU-72) with the State of Connecticut Department of Revenue Services (DRS) in the amount of 5% of the total contract price. This Bond will secure payment for applicable taxes payable to the State related to this Project. The State will issue a Certificate of Compliance once an

acceptable bond has been submitted by the Non-Resident Contractor. This Certificate of Compliance must be provided by the Contractor to the Town prior to the release of the first progress payment under the Contract, or the Town must remit 5% of the total contract value directly to the State. This 5% is in addition to the Project retainage.

Special Notice SN2012(2), published by the State of Connecticut Department of Revenue Services, details the procedures and requirements regarding the Guarantee Bond or Cash Bond. The Special Notice and bond forms can be obtained at the State of Connecticut Department of Revenue Services webpage, www.ct.gov/DRS.

10. Insurance

The Contractor must provide a CERTIFICATE OF INSURANCE as specified in the General, Supplementary Conditions and Special Provisions sections.

11. Receipt of Bonds & Insurance Certificates Prior to Signing Contract

The Contractor to whom the contract shall be awarded must file the requisite BONDS and CERTIFICATE OF INSURANCE as specified and any other forms and documents required by the specifications prior to signing of the contract, and within 7 days from the date of receipt of notification of said award.

12. Obligation of Bidder

Bidders, if requested, must be able to present evidence satisfactory to the Purchasing Agent that they have been regularly engaged in the business of constructing such work as they propose to execute, and that they are fully prepared with the necessary capital, materials, and equipment to conduct the work to be contracted for, and to begin it promptly when ordered.

Prior to submitting his bid, the bidder must inspect the site and thoroughly read all plans, specifications, bid and contract documents. The failure or omission of any bidder to examine any form, instrument or document and to thoroughly examine the site shall in no way relieve any bidder from any obligations in respect to his bid.

13. Damages for Failure to Enter into Contract

The party to whom the CONTRACT is awarded will be required to execute the CONTRACT within thirty (30) calendar days from the date when Notice of Award is delivered to the BIDDER. In case of failure of the BIDDER to execute the CONTRACT, the OWNER may at his option, consider the BIDDER in default, in which case the bid security accompanying the proposal shall become the

property of the OWNER as liquidated damages and not as a penalty.

14. Execution of Contract and Notice to Proceed

The OWNER within 15 days of receipt of acceptable PERFORMANCE BOND, PAYMENT BOND and CONTRACT signed by the party to whom the CONTRACT was awarded shall sign the CONTRACT and return to such party an executed duplicate of the CONTRACT. Should the OWNER not execute the CONTRACT within such period, the BIDDER may by written notice withdraw his signed CONTRACT. Such notice of withdrawal shall be effective upon receipt of the notice by the OWNER.

The Notice to Proceed shall be issued within ten (10) days of the execution of the CONTRACT by the OWNER. Should there be reasons why the Notice to Proceed cannot be issued within such period, the time may be extended by mutual agreement between the OWNER and the CONTRACTOR. If the Notice to Proceed has not been issued within the ten (10) day period or within the period mutually agreed upon, the CONTRACTOR may terminate the CONTRACT, whereupon it shall become null and void and all rights and obligations created thereunder shall be extinguished.

15. Time of Completion and Liquidated Damages

BIDDER must agree to commence work on or before a date to be specified in a written Notice to Proceed from the OWNER and to fully complete the project within 365 consecutive calendar days thereafter. Bidder must agree also to pay as liquidated damages, the sum of \$1,000 for each consecutive calendar day thereafter as hereinafter provided in the GENERAL CONDITIONS.

It is hereby understood and mutually agreed, by and between the CONTRACTOR and the OWNER, that the date of beginning and the time for completion during the working hours as specified in the General Conditions of the work to be done hereunder are essential conditions of this CONTRACT; and it is further mutually understood and agreed that the work embraced in this CONTRACT shall be commenced on a date to be specified in the "Notice to Proceed".

The CONTRACTOR agrees that said work shall be prosecuted regularly, diligently, and uninterruptedly at such rate of progress as will insure full completion thereof within the time specified. It is expressly understood and agreed, by and between the CONTRACTOR and the OWNER, that the time for the completion of the work described herein is a reasonable time for the completion of same, taking into consideration the average climatic range and usual industrial conditions prevailing in this locality.

If the said CONTRACTOR shall neglect, fail or refuse to complete the work within the time herein specified, or any proper extensions thereof granted by the OWNER, then the CONTRACTOR does hereby agree, as a part consideration for the awarding of this CONTRACT, to pay to the OWNER the sum of \$1,000 for each consecutive calendar day as shown above, not as a

penalty but as liquidated damages for such breach of CONTRACT as hereinafter set forth, for each and every calendar day that the CONTRACTOR shall be in default after the time stipulated in the CONTRACT for completion of the work.

The said amount is fixed and agreed upon by and between the CONTRACTOR and the OWNER because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the OWNER would in such event sustain, and said amount is agreed to be the amount of damages which the OWNER would sustain and said amount shall be retained from time to time by the OWNER from current periodic estimates.

It is further agreed that time is of the essence of each and every portion of this CONTRACT and of the specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the CONTRACT an additional time is allowed for the completion of any work, the new time limit fixed by such extension shall be of the essence of this CONTRACT. The CONTRACTOR shall not be in default when the delay in completion of the work is due:

- A. To any preference, priority or allocation order duly issued by the State or Federal Government.
- B. To unforeseeable cause beyond the control and without the fault or negligence of the CONTRACTOR, including, but not limited to, acts of God, or of the public enemy, acts of the OWNER, acts of another contractor in the performance of a contract with the OWNER, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes and severe weather.

The CONTRACTOR shall, within ten (10) days from the beginning of any such delay, unless the OWNER shall grant a further period of time prior to the date of final settlement of the CONTRACT, notify the OWNER, in writing, of the causes of the delay. The Owner shall ascertain the facts and extent of the delay and notify the CONTRACTOR within a reasonable time of its decision in the matter.

16. Addenda and Interpretations

All questions about the meaning or intent of the Contract Documents are to be directed to the Purchasing Agent bmoses@waterfordct.org. Interpretations or clarifications considered necessary by the Owner in response to such questions will be issued by Addenda delivered to all parties recorded by the Owner as having received the Bidding Documents. Questions received less than seven days prior to the date for opening of Bids may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

Addenda will be issued to modify the Bidding Documents as deemed advisable by the Owner.

17. Substitution Clause

Wherever in the Plans and Specifications any item of equipment or material is designed by reference to a particular brand, manufacturer, or trade name, it is understood that an approved equal product, acceptable to the OWNER, may be substituted by the BIDDER or the CONTRACTOR.

18. Retainage

The Town of Waterford reserves the right to retain 5% in addition to the other retainages required, of the final contract price for a period not to exceed six (6) months from the date of final acceptance of the project.

19. Laws and Regulations

The bidder's attention is directed to the fact that all applicable Federal and State law, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the contract throughout, and they will be deemed to be included in the contract the same as though herein written out in full.

20. List of Utilities in the Area

Attention is called to the fact that the following Utility Companies have facilities in the area: The Connecticut Light and Power Company dba Eversource Energy, Lightower Fiber Networks I, LLC dba Crown Castle Fiber, The Southern New England Telephone Company dba Frontier Communications of Connecticut, Comcast of Connecticut, Inc., Yankee Gas Services Company dba Eversource Energy – Gas Distribution, City of New London Department of Public Utilities – Water and Sewer, and Waterford Water Pollution Control Authority.

Information and data reflected in the Contract Documents with respect to Underground Facilities at or contiguous to the site is based upon information and data furnished to Owner by owners of such Underground Facilities or others, and Owner does not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise in the Supplementary Conditions.

The Contractor should acquaint itself with and adhere to the regulations of those utilities which are in the area of this Contract.

When requested by the Contractor, all underground utilities will be located and marked on the surface by the controlling utility company at no cost to him. Contractor will be responsible for notifying the Utility clearinghouse, "Call-Before-You-Dig" 48 hours prior to any excavation, to allow for the location of the existing utilities by controlling Utility Company.

21. Sales Tax

Under the terms of the regulations referring to CONTRACTORS and SUBCONTRACTORS, issued by the STATE TAX COMMISSION in administration of the STATE Sales and Use Tax, to which the BIDDER is referred, the CONTRACTOR may purchase materials or supplies to be consumed in the performance of this contract without payment of tax and shall not include in his bid nor charge any use or sales tax thereon.

22. Site Investigation and Conditions Affecting the Work

Arrangements to visit the site may be made by contacting the Director Waterford Utility Commission Jim Bartelli at jbartelli@waterfordct.org (860) 444-5886 Monday through Friday, 8:30 a.m. to 3:30 p.m.

- A. The Contractor acknowledges that it has taken steps reasonably necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to:
 - 1. Conditions bearing upon transportation, disposal, handling, and storage of materials;
 - 2. The availability of labor, water, electric power, and roads;
 - 3. Conditions at the site;
 - 4. The conformation and conditions of the ground; and
 - 5. The character of equipment and facilities needed preliminary to and during work performance.
- B. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the Town, as well from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the actions described and acknowledged in this paragraph will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the Town.
- C. The Town assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Town. Nor does the Town assume responsibility for any understanding reached or representation made concerning conditions, which can affect the work by any of its officers or agents before the execution of this contract, unless that understanding or representation is expressly stated in this Contract.

- D. The Contract Documents contain the provisions required for the construction of the project. Information obtained from an officer, agent or employee of the OWNER or any other person shall not affect the risks or obligations assumed by the CONTRACTOR or relieve him from fulfilling any of the conditions of the CONTRACT.

23. Permits

The Contractor must obtain all necessary construction and building permits. All building permit fees will be waived except the State of CT Education fee.

24. Work Area

Construction will be confined to the immediate work area only. Trespass on property other than Town property or easements acquired by the Town for the project will be by written permission of the property owner only.

25. Change Orders

Any deviations from, additions to, or deductions from either scope of work or contract price shall be submitted by the Contractor to the Town in the form of a contract change order. The Town must approve this contract change order before said deviations, additions, or deductions shall be enacted. The specific procedures applicable to change orders are set forth in the General Conditions of the Contract Documents.

Further, all changes in scope of work involving unit price items shall be governed by the unit price indicated by the Contractor on the Base Bid Form.

26. Wages

Bidder is directed to the Supplementary Conditions of the Contract Documents for wage rate scales and legislation applicable to this contract.

27. Unbalanced Bids

An unbalanced bid is one in which the contractor's unit prices are:

- a. Significantly higher or lower than the Engineer's estimate.
- b. "Front loaded" so contractor receives a disproportionate payment for work done during the early stages of a project.
- c. Token bid prices (i.e. penny unit bids).

While it is often impossible to designate precisely the dividing line between a balanced bid and an unbalanced bid, contractors should be aware that the Town may regard the unbalancing of a bid as so extreme, undeniable, or detrimental to the interests of the Town that it may question the contractor about the apparent unbalancing of the bid proposal, and, if the contractor cannot provide a

satisfactory explanation of the apparent unbalancing, and if the Town's assessment of the risk to itself is unacceptable, the Town may reject the bid as nonresponsive.

28. OSHA Violations

In accordance with Connecticut General Statute Section 31-57b, no contract shall be awarded to a bidder if it is determined that the bidder (person or firm) has been cited for three (3) or more willful or serious violations of any occupational safety and health act or of any standard, order or regulation promulgated pursuant to such act during the three (3) year period preceding the date of bid opening.

29. Enumeration of the Proposed Contract Documents

Copies of the proposed Contract Documents have been made available to the bidder and consist of the documents enumerated below. The successful bidder selected by the Town shall be expected to enter into the contract documents with the Town. If a bidder is unwilling or unable to meet any of the contract terms, the bidder must disclose that inability or unwillingness in its proposal and the reason(s) therefore. The Town reserves the right to modify or include other provisions in its contracts as the Town, in its sole discretion, deems necessary or advisable.

- A. Project Manual
- B. Construction Plans

BID PROPOSAL
Bid#23-126 Old Norwich Road Sewer Pump Station Upgrades
Town of Waterford

Proposal of _____ hereinafter called
"BIDDER"

*a corporation of the State of

*a partnership, or

*an individual doing business as

To the Town of Waterford, Connecticut

Gentlemen:

The undersigned hereby declares that no person or persons other than those named herein are interested in this proposal or in the Contract proposed to be taken; that it is made without any connection with any other person making any proposal for the same work, and is in all respects fair and without collusion or fraud; that no person acting for or employed by the Town of Waterford is directly interested therein, or in the supplies or works to which it relates, or in any portion of the profits thereof; that it is understood that the Town, its agents and employees are not to be in any manner held responsible for the accuracy of, or bound by, the estimates or borings or plan of borings relative to the work and appearing on plans or in the foregoing notice; and that all such estimates, etc., are to be considered solely for the purpose of filling out and comparing the several proposals.

The undersigned further declares that he has carefully examined the Information for Bidders, Contract documents, including the Plans and Specifications, and has inspected the site and will contract to provide all necessary tools, apparatus and implements, freight, cartage, and expense, and to do all the work and furnish all the materials necessary in the manner and upon the conditions specified and upon the following terms at the prices specified on the following pages.

The undersigned agrees to furnish satisfactory bonds and insurance as required by the General Conditions, the Information for Bidders and by the Supplementary Conditions, and to execute within 30 days after notice of the award, a formal contract with the Town of Waterford for the fulfillment of this proposal, and it is agreed that in case of failure on the part of the undersigned to do so, the certified check or bid bond deposited herewith shall be forfeited to the Town of Waterford as liquidated damages for such failure.

BIDDER hereby agrees to commence work under this contract on or before a date to be specified in written NOTICE TO PROCEED of the OWNER and to fully complete the project in strict compliance with the Contract Documents within 365 consecutive calendar days thereafter as stipulated in the specifications. BIDDER further agrees to pay as liquidated damages, the sum of \$1,500 for each consecutive calendar day thereafter as hereinafter provided in Paragraph 15 of the Information for Bidders.

BIDDER acknowledges receipt of the following addendum:

The undersigned further agrees, in case of a corporation or fictitious trade name, that an acceptable certificate will be filed showing the proper officer or person authorized to sign said contract.

Amounts are to be shown in both words and figures. In case of discrepancy, the amount shown in words will govern.

The unit prices shall include all labor, materials, bailing, shoring, removal, overhead, profit, insurance, etc., to cover the finished work of the several kinds called for.

Bidder understands that the Owner reserves the right to reject any or all bids and to waive any formalities in the bidding.

The bidder agrees that this bid shall be good and may not be withdrawn for a period of 90 calendar days after the scheduled closing time for receiving bids.

The bid Security attached in the sum of:

_____dollars
(\$_____)

is to become the property of the Owner in the event the Contract and Contract Bonds are not executed within the time above set forth, as liquidated damages for the delay and additional expense to the Owner caused thereby.

BID SCHEDULE
Bid#23-XX Old Norwich Road Sewer Pump Station Upgrades
Town of Waterford

Item No.	Quantity	Brief Description of Item with Unit Bid Price in Words	Unit Bid In Figures	Amount In Figures
1	Lump Sum	Old Norwich Road Pump Station Upgrades complete and operational, except as noted below. The Sum of \$ _____ Per Lump Sum		\$ _____
2	Allowance	Undocumented Site Conditions The Sum of \$ <u>five thousand dollars</u> <u>and zero cents</u> Amount in Words		\$ <u>5,000</u>
3	Allowance	Utility Company Service Allowance The Sum of \$ <u>ten thousand dollars</u> <u>and zero cents</u> Amount in Words		\$ <u>10,000</u>
4	Allowance	Pump Station Remote Monitoring Programming Allowance The Sum of \$ <u>three thousand dollars</u> <u>and zero cents</u> Amount in Words		\$ <u>3,000</u>

TOTAL BID: Total of Items 1 through 4 above.

(\$ _____)

(Amount in Figures)

(Amount in Words)

Bid#23-126 Old Norwich Road Sewer Pump Station Upgrades

ATTACHMENT A
Commission on Human Rights and Opportunities
Contract Compliance Regulations Notification to
Bidders

COMMISSION ON HUMAN RIGHTS AND OPPORTUNITIES
CONTRACT COMPLIANCE REGULATIONS
NOTIFICATION TO BIDDERS

(Revised 09/3/15)

The contract to be awarded is subject to contract compliance requirements mandated by Sections 4a-60 and 4a-60a of the Connecticut General Statutes; and, when the awarding agency is the State, Sections 46a-71(d) and 46a-81i(d) of the Connecticut General Statutes. There are Contract Compliance Regulations codified at Section 46a-68j-21 through 43 of the Regulations of Connecticut State Agencies, which establish a procedure for awarding all contracts covered by Sections 4a-60 and 46a-71(d) of the Connecticut General Statutes.

According to Section 46a-68j-30(9) of the Contract Compliance Regulations, every agency awarding a contract subject to the contract compliance requirements has an obligation to “aggressively solicit the participation of legitimate minority business enterprises as bidders, contractors, subcontractors and suppliers of materials.” “Minority business enterprise” is defined in Section 4a-60 of the Connecticut General Statutes as a business wherein fifty-one percent or more of the capital stock, or assets belong to a person or persons: “(1) Who are active in daily affairs of the enterprise; (2) who have the power to direct the management and policies of the enterprise; and (3) who are members of a minority, as such term is defined in subsection (a) of Section 32-9n.” “Minority” groups are defined in Section 32-9n of the Connecticut General Statutes as “(1) Black Americans . . . (2) Hispanic Americans . . . (3) persons who have origins in the Iberian Peninsula . . . (4) Women . . . (5) Asian Pacific Americans and Pacific Islanders; (6) American Indians . . .” An individual with a disability is also a minority business enterprise as provided by Section 4a-60g of the Connecticut General Statutes. The above definitions apply to the contract compliance requirements by virtue of Section 46a-68j-21(11) of the Contract Compliance Regulations.

The awarding agency will consider the following factors when reviewing the bidder’s qualifications under the contract compliance requirements:

- (a) the bidder’s success in implementing an affirmative action plan;
- (b) the bidder’s success in developing an apprenticeship program complying with Sections 46a-68-1 to 46a-68-17 of the Administrative Regulations of Connecticut State Agencies, inclusive;
- (c) the bidder’s promise to develop and implement a successful affirmative action plan;
- (d) the bidder’s submission of employment statistics contained in the “Employment Information Form”, indicating that the composition of its workforce is at or near parity when compared to the racial and sexual composition of the workforce in the relevant labor market area; and
- (e) the bidder’s promise to set aside a portion of the contract for legitimate minority business enterprises. See Section 46a-68j-30(10) (E) of the Contract Compliance Regulations.

INSTRUCTIONS AND OTHER INFORMATION

The following BIDDER CONTRACT COMPLIANCE MONITORING REPORT must be completed in full, signed, and submitted with the bid for this contract. The contract awarding agency and the Commission on Human Rights and Opportunities will use the information contained thereon to determine the bidder’s compliance to Sections 4a-60 and 4a-60a CONN. GEN. STAT., and Sections 46a-68j-23 of the Regulations of Connecticut State Agencies regarding equal employment opportunity, and the bidder’s good faith efforts to include minority business enterprises as subcontractors and suppliers for the work of the contract.

1) Definition of Small Contractor

Section 4a-60g CONN. GEN. STAT. defines a small contractor as a company that has been doing business under the same management and control and has maintained its principal place of business in Connecticut for a one year period immediately prior to its application for certification under this section, had gross revenues not exceeding fifteen million dollars in the most recently completed fiscal year, and at least fifty-one percent of the ownership of which is held by a person or persons who are active in the daily affairs of the company, and have the power to direct the management and policies of the company, except that a nonprofit corporation shall be construed to be a small contractor if such nonprofit corporation meets the requirements of subparagraphs (A) and (B) of subdivision 4a-60g CONN. GEN. STAT.

MANAGEMENT: Managers plan, organize, direct, and control the major functions of an organization through subordinates who are at the managerial or supervisory level. They make policy decisions and set objectives for the company or departments. They are not usually directly involved in production or providing services. Examples include top executives, public relations managers, managers of operations specialties (such as financial, human resources, or purchasing managers), and construction and engineering managers.

BUSINESS AND FINANCIAL OPERATIONS: These occupations include managers and professionals who work with the financial aspects of the business. These occupations include accountants and auditors, purchasing agents, management analysts, labor relations specialists, and budget, credit, and financial analysts.

MARKETING AND SALES: Occupations related to the act or process of buying and selling products and/or services such as sales engineer, retail sales workers and sales representatives including wholesale.

LEGAL OCCUPATIONS: In-House Counsel who is charged with providing legal advice and services in regards to legal issues that may arise during the course of standard business practices. This category also includes assistive legal occupations such as paralegals, legal assistants.

COMPUTER SPECIALISTS: Professionals responsible for the computer operations within a company are grouped in this category. Examples of job titles in this category include computer programmers, software engineers, database administrators, computer scientists, systems analysts, and computer support specialists

ARCHITECTURE AND ENGINEERING: Occupations related to architecture, surveying, engineering, and drafting are included in this category. Some of the job titles in this category include electrical and electronic engineers, surveyors, architects, drafters, mechanical engineers, materials engineers, mapping technicians, and civil engineers.

OFFICE AND ADMINISTRATIVE SUPPORT: All clerical-type work is included in this category. These jobs involve the preparing, transcribing, and preserving of written communications and records; collecting accounts; gathering and distributing information; operating office machines and electronic data processing equipment; and distributing mail. Job titles listed in this category include telephone operators, bill and account collectors, customer service representatives, dispatchers, secretaries and administrative assistants, computer operators and clerks (such as payroll, shipping, stock, mail and file).

BUILDING AND GROUNDS CLEANING AND MAINTENANCE: This category includes occupations involving landscaping, housekeeping, and janitorial services. Job titles found in this category include supervisors of landscaping or housekeeping, janitors, maids, grounds maintenance workers, and pest control workers.

CONSTRUCTION AND EXTRACTION: This category includes construction trades and related occupations. Job titles found in this category include boilermakers, masons (all types), carpenters, construction laborers, electricians, plumbers (and related trades), roofers, sheet metal workers, elevator installers, hazardous materials removal workers, paperhangers, and painters. Paving, surfacing, and tamping equipment operators; drywall and ceiling tile installers; and carpet, floor and tile installers and finishers are also included in this category. First line supervisors, foremen, and helpers in these trades are also grouped in this category.

INSTALLATION, MAINTENANCE AND REPAIR: Occupations involving the installation, maintenance, and repair of equipment are included in this group. Examples of job titles found here are heating, ac, and refrigeration mechanics and installers; telecommunication line installers and repairers; heavy vehicle and mobile equipment service technicians and mechanics; small engine mechanics; security and fire alarm systems installers; electric/electronic repair, industrial, utility and transportation equipment; millwrights; riggers; and manufactured building and mobile home installers. First line supervisors, foremen, and helpers for these jobs are also included in the category.

MATERIAL MOVING WORKERS: The job titles included in this group are Crane and tower operators; dredge, excavating, and lading machine operators; hoist and winch operators; industrial truck and tractor operators; cleaners of vehicles and equipment; laborers and freight, stock, and material movers, hand; machine feeders and off bearers; packers and packagers, hand; pumping station operators; refuse and recyclable material collectors; and miscellaneous material moving workers.

PRODUCTION WORKERS: The job titles included in this category are chemical production machine setters, operators and tenders; crushing/grinding workers; cutting workers; inspectors, testers sorters, samplers, weighers; precious stone/metal workers; painting workers; cementing/gluing machine operators and tenders; etchers/engravers; molders, shapers and casters except for metal and plastic; and production workers.

3) Definition of Racial and Ethnic Terms (as used in Part IV Bidder Employment Information) (Page 3)

<u>White</u> (not of Hispanic Origin)- All persons having origins in any of the original peoples of Europe, North Africa, or the Middle East. <u>Black</u> (not of Hispanic Origin)- All persons having origins in any of the Black racial groups of Africa. <u>Hispanic</u>- All persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.	<u>Asian or Pacific Islander</u>- All persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent, or the Pacific Islands. This area includes China, India, Japan, Korea, the Philippine Islands, and Samoa. <u>American Indian or Alaskan Native</u>- All persons having origins in any of the original peoples of North America, and who maintain cultural identification through tribal affiliation or community recognition.
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BIDDER CONTRACT COMPLIANCE MONITORING REPORT

PART I - Bidder Information

Company Name Street Address City & State Chief Executive	Bidder Federal Employer Identification Number _____ Or Social Security Number _____
Major Business Activity (brief description)	Bidder Identification (response optional/definitions on page 1) -Bidder is a small contractor. Yes__No -Bidder is a minority business enterprise Yes __No (If yes, check ownership category) Black__Hispanic__Asian American__American Indian/Alaskan Native__Iberian Peninsula__Individual(s) with a Physical Disability____ Female____
Bidder Parent Company (If any)	- Bidder is certified as above by State of CT Yes__ No
Other Locations in Ct. (If any)	

PART II - Bidder Nondiscrimination Policies and Procedures

1. Does your company have a written Affirmative Action/Equal Employment Opportunity statement posted on company bulletin boards? Yes__No	7. Do all of your company contracts and purchase orders contain non-discrimination statements as required by Sections 4a-60 & 4a-60a Conn. Gen. Stat.? Yes__No
2. Does your company have the state-mandated sexual harassment prevention in the workplace policy posted on company bulletin boards? Yes__No	8. Do you, upon request, provide reasonable accommodation to employees, or applicants for employment, who have physical or mental disability? Yes__No
3. Do you notify all recruitment sources in writing of your company's Affirmative Action/Equal Employment Opportunity employment policy? Yes__No__	9. Does your company have a mandatory retirement age for all employees? Yes__No
4. Do your company advertisements contain a written statement that you are an Affirmative Action/Equal Opportunity Employer? Yes__No	10. If your company has 50 or more employees, have you provided at least two (2) hours of sexual harassment training to all of your supervisors? Yes__No__NA
5. Do you notify the Ct. State Employment Service of all employment openings with your company? Yes__No	11. If your company has apprenticeship programs, do they meet the Affirmative Action/Equal Employment Opportunity requirements of the apprenticeship standards of the Ct. Dept. of Labor? Yes__No__NA__
6. Does your company have a collective bargaining agreement with workers? Yes__No 6a. If yes, do the collective bargaining agreements contain non-discrimination clauses covering all workers? Yes__No 6b. Have you notified each union in writing of your commitments under the nondiscrimination requirements of contracts with the state of Ct? Yes__No	12. Does your company have a written affirmative action Plan? Yes __No If no, please explain. 13. Is there a person in your company who is responsible for equal employment opportunity? Yes__No If yes, give name and phone number. _____

1. Will the work of this contract include subcontractors or suppliers? Yes__No

1a. If yes, please list all subcontractors and suppliers and report if they are a small contractor and/or a minority business enterprise. (defined on page 1 / use additional sheet if necessary)

1b. Will the work of this contract require additional subcontractors or suppliers other than those identified in 1a. above? Yes__No

PART IV - Bidder Employment Information Date:

JOB CATEGORY *	OVERALL TOTALS	WHITE (not of Hispanic origin)		BLACK (not of Hispanic origin)		HISPANIC		ASIAN or PACIFIC ISLANDER		AMERICAN INDIAN or ALASKAN NATIVE	
		Male	Female	Male	Female	Male	Female	Male	Female	male	female
Management											
Business & Financial Ops											
Marketing & Sales											
Legal Occupations											
Computer Specialists											
Architecture/Engineering											
Office & Admin Support											
Bldg./ Grounds Cleaning/Maintenance											
Construction & Extraction											
Installation , Maintenance & Repair											
Material Moving Workers											
Production Occupations											
TOTALS ABOVE											
Total One Year Ago											
FORMAL ON THE JOB TRAINEES (ENTER FIGURES FOR THE SAME CATEGORIES AS ARE SHOWN ABOVE)											
Apprentices											
Trainees											

*NOTE: JOB CATEGORIES CAN BE CHANGED OR ADDED TO (EX. SALES CAN BE ADDED OR REPLACE A CATEGORY NOT USED IN YOUR COMPANY)

1. Which of the following recruitment sources are used by you? (Check yes or no, and report percent used)				2. Check (X) any of the below listed requirements that you use as a hiring qualification (X)		3. Describe below any other practices or actions that you take which show that you hire, train, and promote employees without discrimination
SOURCE	YES	NO	% of applicants provided by source			
State Employment Service					Work Experience	
Private Employment Agencies					Ability to Speak or Write English	
Schools and Colleges					Written Tests	
Newspaper Advertisement					High School Diploma	
Walk Ins					College Degree	
Present Employees					Union Membership	
Labor Organizations					Personal Recommendation	
Minority/Community Organizations					Height or Weight	
Others (please identify)					Car Ownership	
					Arrest Record	
					Wage Garnishments	

Certification (Read this form and check your statements on it CAREFULLY before signing). I certify that the statements made by me on this BIDDER CONTRACT COMPLIANCE MONITORING REPORT are complete and true to the best of my knowledge and belief, and are made in good faith. I understand that if I knowingly make any misstatements of facts, I am subject to be declared in non-compliance with Section 4a-60, 4a-60a, and related sections of the CONN. GEN. STAT.

(Signature)	(Title)	(Date Signed)	(Telephone)
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Bid#23-126 Old Norwich Road Sewer Pump Station Upgrades

ATTACHMENT B
Commission on Human Rights and Opportunities
Non-Discrimination and Affirmative Action
Provisions

Non-Discrimination and Affirmative Action Provisions

- (A)(1) The Contractor agrees and warrants that in the performance of the Contract such Contractor will not discriminate or permit discrimination against any person or group of persons on the grounds of race, color, religious creed, age, marital status, national origin, ancestry, sex, gender identity or expression, sexual orientation, intellectual disability, mental disability or physical disability, including, but not limited to, blindness, unless it is shown by such Contractor that such disability prevents performance of the work involved, in any manner prohibited by the laws of the United States or of the state of Connecticut. The Contractor further agrees to take affirmative action to insure that applicants with job-related qualifications are employed and that employees are treated when employed without regard to of race, color, religious creed, age, marital status, national origin, ancestry, sex, gender identity or expression, intellectual disability, mental disability or physical disability, including, but not limited to, blindness, unless it is shown by such Contractor that such disability prevents performance of the work involved; (2) the Contractor agrees, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, to state that it is an "affirmative action-equal opportunity employer" in accordance with regulations adopted by the commission; (3) the Contractor agrees to provide each labor union or representative of workers with which such Contractor has a collective bargaining agreement or other contract or understanding and each vendor with which such Contractor has a contract or understanding, a notice to be provided by the commission advising the labor union or workers' representative of the Contractor's commitments under this section, and to post copies of the notice in conspicuous places available to employees and applicants for employment; (4) the Contractor agrees to comply with each provision of this section and sections 46a-68e and 46a-68f and with each regulation or relevant order issued by said commission pursuant to sections 46a-56, 46a-68e, 46a-68f and 46a-86; (5) the Contractor agrees to provide the Commission on Human Rights and Opportunities with such information requested by the commission, and permit access to pertinent books, records and accounts, concerning the employment practices and procedures of the Contractor as relate to the provisions of this section and section 46a-56.
- (B) Any Contractor who is a party to a municipal public works contract or quasi-public agency project, where any such contract is valued at less than \$50,000 for each year of the contract, shall provide the Commission on Human Rights and Opportunities with a written or electronic representation that complies with the nondiscrimination agreement and warranty under subsection (A)(1) above, provided if there is any change in such representation, the Contractor shall provide the updated representation to the Commission not later than 30 days after such change. Any Contractor who is a party to a municipal public works contract or a quasi-public agency project, where any such contract is valued at \$50,000 or more for any year of the contract, shall provide the Commission with any one of the following: (1) Documentation in the form of a company or corporate policy adopted by resolution of the board of directors, shareholder, managers, members or other governing body of such Contractor that complies with the nondiscrimination agreement and warranty under subsection (A)(1) of this section; (2) Documentation in the form of a company or corporate policy adopted by a prior resolution of the board of directors, shareholders, managers, members or other governing body of such contractor if (a) the prior resolution is certified by a duly authorized corporate officer of such contractor to be in effect on the date the documentation is submitted, and the executive director of the Commission on Human Rights and Opportunities or designee certifies that the prior resolution complies with the nondiscrimination agreement and warranty under subdivision (A)(1) of this section; or (3) Documentation in the form of an affidavit signed under penalty of false statement by a chief executive officer, president, chairperson or other corporate officer duly authorized to adopt company or corporate policy that certifies that the company or corporate policy of the contractor complies with the nondiscrimination agreement and warranty under subdivision (A)(1) of this section and is in effect on the date the affidavit is signed.

- (C) If the Contract is a municipal public works contract or a quasi-public agency project, the Contractor agrees and warrants that s/he will make good faith efforts to employ minority business enterprises as subcontractors and suppliers of materials on such public works project. The Contractor shall include the provisions of subdivision (A)(1) of this section in every subcontract or purchase order entered into to fulfill any obligation of a municipal public works contract or contract for a quasi-public agency project, and such provisions shall be binding on a subcontractor, vendor or manufacturer, unless exempted by regulations or orders of the Commission on Human Rights and Opportunities. The Contractor shall take such action with respect to any such subcontract or purchase order as the Commission may direct as a means of enforcing such provisions, including sanctions for noncompliance in accordance with section 46a-56; provided, if such Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Commission regarding a state contract, the contractor may request the state of Connecticut to enter into any such litigation or negotiation prior thereto to protect the interests of the state and the state may so enter.
- (D) "Minority business enterprise" means any small contractor or supplier of materials fifty-one per cent or more of the capital stock, if any, or assets of which is owned by a person or persons: (1) Who are active in the daily affairs of the enterprise, (2) who have the power to direct the management and policies of the enterprise and (3) who are members of a minority, as such term is defined in subsection (a) of section 32-9n; and "good faith" means that degree of diligence which a reasonable person would exercise in the performance of legal duties and obligations. "Good faith efforts" shall include, but not be limited to, those reasonable initial efforts necessary to comply with statutory or regulatory requirements and additional or substituted efforts when it is determined that such initial efforts will not be sufficient to comply with such requirements. Determination of the Contractor's good faith efforts shall include, but shall not be eliminated to, the following factors: The contractor's employment and subcontracting policies, patterns and practices; affirmative advertising recruitment and training; technical assistance activities and such other reasonable activities or efforts as the Commission on Human Rights and Opportunities may prescribe that are designed to ensure the participation of minority business enterprises in municipal public works contracts or quasi-public agency projects. "Municipal public works project" means that portion of an agreement entered into on or after October 1, 2015, between any individual, firm or corporation and a municipality for the construction, rehabilitation, conversion, extension, demolition or repair of a public building, highway or other changes or improvements in real property, which is financed in whole or in part by the state, including, but not limited to, matching expenditures, grants, loans, insurance or guarantees but excluding any project of an alliance district, as defined in section 10-262u, finance by the state funding in an amount equal to fifty thousand dollars or less. "Quasi-public agency project" means the construction, rehabilitation, conversion, extension, demolition or repair of a building or other changes or improvements in real property pursuant to a contract entered into on or after October 1, 2015, which is financed in whole or in part by a quasi-public agency using state funds, including, but not limited to, matching expenditures, grants, loans, insurance or guarantees.

Bid#23-126 Old Norwich Road Sewer Pump Station Upgrades

ATTACHMENT C
Construction Contracts – Required Contract
Provisions (State Funded Only Contracts)

Construction Contracts - Required Contract Provisions (State Funded Only Contracts)

Index

1. Title VI of the Civil Rights Act of 1964 / Nondiscrimination Requirements
2. Contractor Work Force Utilization / Specific Equal Employment Opportunity
3. Contract Wage Rates
4. Americans with Disabilities Act of 1990, as Amended
5. Connecticut Statutory Labor Requirements
 - a. Construction, Alteration or Repair of Public Works Projects; Wage Rates
 - b. Debarment List - Limitation on Awarding Contracts
 - c. Construction Safety and Health Course
 - d. Awarding of Contracts to Occupational Safety and Health Law Violators Prohibited
 - e. Residents Preference in Work on Other Public Facilities (Not Applicable to Federal Aid Contracts)
6. Tax Liability - Contractor's Exempt Purchase Certificate (CERT – 141)
7. Executive Orders (State of CT)
8. Non Discrimination Requirement (pursuant to section 4a-60 and 4a-60a of the Connecticut General Statutes, as revised)
9. Whistleblower Provision
10. Connecticut Freedom of Information Act
 - a. Disclosure of Records
 - b. Confidential Information
11. Service of Process
12. Substitution of Securities for Retainages on State Contracts and Subcontracts
13. Health Insurance Portability and Accountability Act of 1996 (HIPAA)
14. Forum and Choice of Law
15. Summary of State Ethics Laws
16. Audit and Inspection of Plants, Places of Business and Records
17. Campaign Contribution Restriction

- 18. Tangible Personal Property
- 19. Bid Rigging and/or Fraud – Notice to Contractor
- 20. Consulting Agreement Affidavit

Index of Exhibits

- EXHIBIT A – Title VI Contractor Assurances (page 13)
- EXHIBIT B – Contractor Work Force Utilization / Equal Employment Opportunity (page 14)
- EXHIBIT C – Health Insurance Portability and Accountability Act of 1996 (HIPAA) (page 17)
- EXHIBIT D - Campaign Contribution Restriction (page 25)
- EXHIBIT E - State Wage Rates (Attached at the end)

1. Title VI of the Civil Rights Act of 1964 / Nondiscrimination Requirements

The Contractor shall comply with Title VI of the Civil Rights Act of 1964 as amended (42 U.S.C. 2000 et seq.), all requirements imposed by the regulations of the United States Department of Transportation (49 CFR Part 21) issued in implementation thereof, and the Title VI Contractor Assurances attached hereto at Exhibit A, all of which are hereby made a part of this Contract.

2. Contractor Work Force Utilization / Equal Employment Opportunity

- (a) The Contractor shall comply with the Contractor Work Force Utilization / Equal Employment Opportunity requirements attached at Exhibit B and hereby made part of this Contract, whenever a contractor or subcontractor at any tier performs construction work in excess of \$10,000. These goals shall be included in each contract and subcontract. Goal achievement is calculated for each trade using the hours worked under each trade.
- (b) Companies with contracts, agreements or purchase orders valued at \$10,000 or more will develop and implement an Affirmative Action Plan utilizing the Conn DOT Affirmative Action Plan Guideline. This Plan shall be designed to further the provision of equal employment opportunity to all persons without regard to their race, color, religion, sex or national origin, and to promote the full realization of equal employment opportunity through a positive continuation program. Plans shall be updated as required by Conn DOT.

3. Contract Wage Rates

The Contractor shall comply with:

The State wage rate requirements indicated in Exhibit E hereof are hereby made part of this Contract.

Prevailing Wages for Work on State Highways; Annual Adjustments. With respect to contracts for work on state highways and bridges on state highways, the Contractor shall comply with the provisions of Section 31-54 and 31-55a of the Connecticut General Statutes, as revised.

As required by section 1.05.12 (Payrolls) of the State of Connecticut, Department of Transportation's Standard Specification for Roads, Bridges and Incidental Construction (FORM 816), as may be revised, every Contractor or subcontractor performing project work on a federal aid project is required to post the relevant prevailing wage rates as determined by the United States Secretary of Labor. The wage rate determinations shall be posted in prominent and easily accessible places at the work site.

4. Americans with Disabilities Act of 1990, as Amended

This provision applies to those Contractors who are or will be responsible for compliance with the terms of the Americans with Disabilities Act of 1990, as amended (42 U.S.C. 12101 et seq.), (Act), during the term of the Contract. The Contractor represents that it is familiar with the terms of this Act and that it is in compliance with the Act. Failure of the Contractor to satisfy this standard as the same applies to performance under this Contract, either now or during the term of the Contract as it may be amended, will render the Contract voidable at the option of the State upon notice to the contractor. The Contractor warrants that it will hold the State harmless and indemnify the State from any liability which may be imposed upon the State as a result of any failure of the Contractor to be in compliance with this Act, as the same applies to performance under this Contract.

5. Connecticut Statutory Labor Requirements

(a) Construction, Alteration or Repair of Public Works Projects; Wage Rates. The Contractor shall comply with Section 31-53 of the Connecticut General Statutes, as revised. The wages paid on an hourly basis to any person performing the work of any mechanic, laborer or worker on the work herein contracted to be done and the amount of payment or contribution paid or payable on behalf of each such person to any employee welfare fund, as defined in subsection (i) of section 31-53 of the Connecticut General Statutes, shall be at a rate equal to the rate customary or prevailing for the same work in the same trade or occupation in the town in which such public works project is being constructed. Any contractor who is not obligated by agreement to make payment or contribution on behalf of such persons to any such employee welfare fund shall pay to each mechanic, laborer or worker as part of such person's wages the amount of payment or contribution for such person's classification on each pay day.

(b) Debarment List. Limitation on Awarding Contracts. The Contractor shall comply with Section 31-53a of the Connecticut General Statutes, as revised.

(c) Construction Safety and Health Course. The Contractor shall comply with section 31-53b of the Connecticut General Statutes, as revised. The contractor shall furnish proof to the Labor Commissioner with the weekly certified payroll form for the first week each employee begins work on such project that any person performing the work of a mechanic, laborer or worker pursuant to the classifications of labor under section 31-53 of the Connecticut General Statutes, as revised, on such public works project, pursuant to such contract, has completed a course of at least ten hours in duration in construction safety and health approved by the federal Occupational Safety and Health Administration or, has completed a new miner training program approved by the Federal Mine Safety and Health Administration in accordance with 30 CFR 48 or, in the case of telecommunications employees, has completed at least ten hours of training in accordance with 29 CFR 1910.268.

Any employee required to complete a construction safety and health course as required that has not completed the course, shall have a maximum of fourteen (14) days to complete the course. If the employee has not been brought into compliance, they shall be removed from the project until such time as they have completed the required training.

Any costs associated with this notice shall be included in the general cost of the contract. In addition, there shall be no time granted to the contractor for compliance with this notice. The contractor's compliance with this notice and any associated regulations shall not be grounds for claims as outlined in Section 1.11 – "Claims".

(d) Awarding of Contracts to Occupational Safety and Health Law Violators Prohibited. The Contract is subject to Section 31-57b of the Connecticut General Statutes, as revised.

(e) Residents Preference in Work on Other Public Facilities. NOT APPLICABLE TO FEDERAL AID CONTRACTS. Pursuant to Section 31-52a of the Connecticut General Statutes, as revised, in the employment of mechanics, laborers or workmen to perform the work specified herein, preference shall be given to residents of the state who are, and continuously for at least six months prior to the date hereof have been, residents of this state, and if no such person is available, then to residents of other states

6. Tax Liability - Contractor's Exempt Purchase Certificate (CERT – 141)

The Contractor shall comply with Chapter 219 of the Connecticut General Statutes pertaining to tangible personal property or services rendered that is/are subject to sales tax. The Contractor is responsible for determining its tax liability. If the Contractor purchases materials or supplies pursuant to the Connecticut Department of Revenue Services' "Contractor's Exempt Purchase Certificate (CERT-141)," as may be revised, the Contractor acknowledges and agrees that title to such materials and supplies installed or placed in the project will vest in the State simultaneously with passage of title from the retailers or vendors thereof, and the Contractor will have no property rights in the materials and supplies purchased.

Forms and instructions are available anytime by:

Internet: Visit the DRS website at www.ct.gov/DRS to download and print Connecticut tax forms; or
Telephone: Call 1-800-382-9463 (Connecticut calls outside the Greater Hartford calling area only) and select Option 2 or call 860-297-4753 (from anywhere).

7. Executive Orders

This contract is subject to the provisions of Executive Order No. Three of Governor Thomas J. Meskill, promulgated June 16, 1971, concerning labor employment practices, Executive Order No. Seventeen of Governor Thomas J. Meskill, promulgated February 15, 1973, concerning the listing of employment openings and Executive Order No. Sixteen of Governor John G. Rowland promulgated August 4, 1999, concerning violence in the workplace, all of which are incorporated into and are made a part of the contract as if they had been fully set forth in it. The contract may also be subject to Executive Order No. 14 of Governor M. Jodi Rell, promulgated April 17, 2006, concerning procurement of cleaning products and services and to Executive Order No. 49 of Governor Dannel P. Malloy, promulgated May 22, 2015, mandating disclosure of certain gifts to public employees and contributions to certain candidates for office. If Executive Order No. 14 and/or Executive Order No. 49 are applicable, they are deemed to be incorporated into and are made a part of the contract as if they had been fully set forth in it. At the Contractor's request, the Department shall provide a copy of these orders to the Contractor.

8. Non Discrimination Requirement (pursuant to section 4a-60 and 4a-60a of the Connecticut General Statutes, as revised): References to "minority business enterprises" in this Section are not applicable to Federal-aid projects/contracts. Federal-aid projects/contracts are instead subject to the Federal Disadvantaged Business Enterprise Program.

(a) For purposes of this Section, the following terms are defined as follows:

- (1) "Commission" means the Commission on Human Rights and Opportunities;
- (2) "Contract" and "contract" include any extension or modification of the Contract or contract;
- (3) "Contractor" and "contractor" include any successors or assigns of the Contractor or contractor;
- (4) "Gender identity or expression" means a person's gender-related identity, appearance or behavior, whether or not that gender-related identity, appearance or behavior is different from that traditionally associated with the person's physiology or assigned sex at birth, which gender-related identity can be shown by providing evidence including, but not limited to, medical history, care or treatment of the gender-related identity, consistent and uniform assertion of the gender-related identity or any other evidence that the gender-related identity is sincerely held, part of a person's core identity or not being asserted for an improper purpose.
- (5) "good faith" means that degree of diligence which a reasonable person would exercise in the performance of legal duties and obligations;

- (6) "good faith efforts" shall include, but not be limited to, those reasonable initial efforts necessary to comply with statutory or regulatory requirements and additional or substituted efforts when it is determined that such initial efforts will not be sufficient to comply with such requirements;
- (7) "marital status" means being single, married as recognized by the state of Connecticut, widowed, separated or divorced;
- (8) "mental disability" means one or more mental disorders, as defined in the most recent edition of the American Psychiatric Association's "Diagnostic and Statistical Manual of Mental Disorders", or a record of or regarding a person as having one or more such disorders;
- (9) "minority business enterprise" means any small contractor or supplier of materials fifty-one percent or more of the capital stock, if any, or assets of which is owned by a person or persons: (1) who are active in the daily affairs of the enterprise, (2) who have the power to direct the management and policies of the enterprise, and (3) who are members of a minority, as such term is defined in subsection (a) of Connecticut General Statutes § 32-9n; and
- (10) "public works contract" means any agreement between any individual, firm or corporation and the State or any political subdivision of the State other than a municipality for construction, rehabilitation, conversion, extension, demolition or repair of a public building, highway or other changes or improvements in real property, or which is financed in whole or in part by the State, including, but not limited to, matching expenditures, grants, loans, insurance or guarantees.

For purposes of this Section, the terms "Contract" and "contract" do not include a contract where each contractor is (1) a political subdivision of the State of Connecticut, including, but not limited to municipalities, unless the contract is a municipal public works contract or quasi-public agency project contract, (2) any other state of the United States, including but not limited to, the District of Columbia, Puerto Rico, U.S. territories and possessions, and federally recognized Indian tribal governments, as defined in Connecticut General Statutes § 1-267, (3) the federal government, (4) a foreign government, or (5) an agency of a subdivision, state or government described in subdivision (1), (2), (3), or (4) of this subsection.

- (b) (1) The Contractor agrees and warrants that in the performance of the Contract such Contractor will not discriminate or permit discrimination against any person or group of persons on the grounds of race, color, religious creed, age, marital status, national origin, ancestry, sex, gender identity or expression, status as a veteran, intellectual disability, mental disability or physical disability, including, but not limited to, blindness, unless it is shown by such Contractor that such disability prevents performance of the work involved, in any manner prohibited by the laws of the United States or of the State of Connecticut; and the Contractor further agrees to take affirmative action to insure that applicants with job-related qualifications are employed and that employees are treated when employed without regard to their race, color, religious creed, age, marital status, national origin, ancestry, sex, gender identity or expression, status as a veteran, intellectual disability, mental disability or physical disability, including, but not limited to, blindness, unless it is shown by the Contractor that such disability prevents performance of the work involved; (2) the Contractor agrees, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, to state that it is an "affirmative action-equal opportunity employer" in accordance with regulations adopted by the Commission; (3) the Contractor agrees to provide each labor union or representative of workers with which the Contractor has a collective bargaining agreement or other contract or understanding and each vendor with which the Contractor has a contract or understanding, a notice to be provided by the Commission, advising the labor union or workers' representative of the Contractor's commitments under this section and to post copies of the notice in conspicuous places available to employees and applicants for employment; (4) the Contractor

agrees to comply with each provision of this Section and Connecticut General Statutes §§ 46a-68e and 46a-68f and with each regulation or relevant order issued by said Commission pursuant to Connecticut General Statutes §§ 46a-56, 46a-68e and 46a-68f; and (5) the Contractor agrees to provide the Commission on Human Rights and Opportunities with such information requested by the Commission, and permit access to pertinent books, records and accounts, concerning the employment practices and procedures of the Contractor as relate to the provisions of this Section and Connecticut General Statutes § 46a-56. If the contract is a public works contract, the Contractor agrees and warrants that he will make good faith efforts to employ minority business enterprises as subcontractors and suppliers of materials on such public works projects.

- (c) Determination of the Contractor's good faith efforts shall include, but shall not be limited to, the following factors: The Contractor's employment and subcontracting policies, patterns and practices; affirmative advertising, recruitment and training; technical assistance activities and such other reasonable activities or efforts as the Commission may prescribe that are designed to ensure the participation of minority business enterprises in public works projects.
- (d) The Contractor shall develop and maintain adequate documentation, in a manner prescribed by the Commission, of its good faith efforts.
- (e) The Contractor shall include the provisions of subsection (b) of this Section in every subcontract or purchase order entered into in order to fulfill any obligation of a contract with the State and such provisions shall be binding on a subcontractor, vendor or manufacturer unless exempted by regulations or orders of the Commission. The Contractor shall take such action with respect to any such subcontract or purchase order as the Commission may direct as a means of enforcing such provisions including sanctions for noncompliance in accordance with Connecticut General Statutes §46a-56; provided if such Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Commission, the Contractor may request the State of Connecticut to enter into any such litigation or negotiation prior thereto to protect the interests of the State and the State may so enter.
- (f) The Contractor agrees to comply with the regulations referred to in this Section as they exist on the date of this Contract and as they may be adopted or amended from time to time during the term of this Contract and any amendments thereto.
- (g) (1) The Contractor agrees and warrants that in the performance of the Contract such Contractor will not discriminate or permit discrimination against any person or group of persons on the grounds of sexual orientation, in any manner prohibited by the laws of the United States or the State of Connecticut, and that employees are treated when employed without regard to their sexual orientation; (2) the Contractor agrees to provide each labor union or representative of workers with which such Contractor has a collective bargaining agreement or other contract or understanding and each vendor with which such Contractor has a contract or understanding, a notice to be provided by the Commission on Human Rights and Opportunities advising the labor union or workers' representative of the Contractor's commitments under this section, and to post copies of the notice in conspicuous places available to employees and applicants for employment; (3) the Contractor agrees to comply with each provision of this section and with each regulation or relevant order issued by said Commission pursuant to Connecticut General Statutes § 46a-56; and (4) the Contractor agrees to provide the Commission on Human Rights and Opportunities with such information requested by the Commission, and permit access to pertinent books, records and accounts, concerning the employment practices and procedures of the Contractor which relate to the provisions of this Section and Connecticut General Statutes § 46a-56.
- (h) The Contractor shall include the provisions of the foregoing paragraph in every subcontract or purchase order entered into in order to fulfill any obligation of a contract with the State and such provisions shall be binding on a subcontractor, vendor or manufacturer unless exempted by regulations or orders of the Commission. The Contractor shall take such action with respect to any such subcontract or purchase order as the Commission may direct as a means of enforcing such

provisions including sanctions for noncompliance in accordance with Connecticut General Statutes § 46a-56; provided, if such Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Commission, the Contractor may request the State of Connecticut to enter into any such litigation or negotiation prior thereto to protect the interests of the State and the State may so enter.

Please be aware the Nondiscrimination Certifications can be found at the Office of Policy and Management website:

<https://portal.ct.gov/OPM/Fin-PSA/Forms/Nondiscrimination-Certification>

9. Whistleblower Provision

The following clause is applicable if the Contract has a value of Five Million Dollars (\$5,000,000) or more.

Whistleblowing. This Contract may be subject to the provisions of Section 4-61dd of the Connecticut General Statutes. In accordance with this statute, if an officer, employee or appointing authority of the Contractor takes or threatens to take any personnel action against any employee of the Contractor in retaliation for such employee's disclosure of information to any employee of the contracting state or quasi-public agency or the Auditors of Public Accounts or the Attorney General under the provisions of subsection (a) of such statute, the Contractor shall be liable for a civil penalty of not more than five thousand dollars for each offense, up to a maximum of twenty per cent of the value of this Contract. Each violation shall be a separate and distinct offense and in the case of a continuing violation, each calendar day's continuance of the violation shall be deemed to be a separate and distinct offense. The State may request that the Attorney General bring a civil action in the Superior Court for the Judicial District of Hartford to seek imposition and recovery of such civil penalty. In accordance with subsection (f) of such statute, each large state contractor, as defined in the statute, shall post a notice of the provisions of the statute relating to large state contractors in a conspicuous place which is readily available for viewing by the employees of the Contractor.

10. Connecticut Freedom of Information Act

(a) Disclosure of Records. This Contract may be subject to the provisions of section 1-218 of the Connecticut General Statutes. In accordance with this statute, each contract in excess of two million five hundred thousand dollars between a public agency and a person for the performance of a governmental function shall (a) provide that the public agency is entitled to receive a copy of records and files related to the performance of the governmental function, and (b) indicate that such records and files are subject to FOIA and may be disclosed by the public agency pursuant to FOIA. No request to inspect or copy such records or files shall be valid unless the request is made to the public agency in accordance with FOIA. Any complaint by a person who is denied the right to inspect or copy such records or files shall be brought to the Freedom of Information Commission in accordance with the provisions of sections 1-205 and 1-206 of the Connecticut General Statutes.

(b) Confidential Information. The State will afford due regard to the Contractor's request for the protection of proprietary or confidential information which the State receives from the Contractor. However, all materials associated with the Contract are subject to the terms of the FOIA and all corresponding rules, regulations and interpretations. In making such a request, the Contractor may not merely state generally that the materials are proprietary or confidential in nature and not, therefore, subject to release to third parties. Those particular sentences, paragraphs, pages or sections that the Contractor believes are exempt from disclosure under the FOIA must be specifically identified as such. Convincing explanation and rationale sufficient to justify each exemption consistent with the FOIA must

accompany the request. The rationale and explanation must be stated in terms of the prospective harm to the competitive position of the Contractor that would result if the identified material were to be released and the reasons why the materials are legally exempt from release pursuant to the FOIA. To the extent that any other provision or part of the Contract conflicts or is in any way inconsistent with this section, this section controls and shall apply and the conflicting provision or part shall not be given effect. If the Contractor indicates that certain documentation is submitted in confidence, by specifically and clearly marking the documentation as "CONFIDENTIAL," DOT will first review the Contractor's claim for consistency with the FOIA (that is, review that the documentation is actually a trade secret or commercial or financial information and not required by statute), and if determined to be consistent, will endeavor to keep such information confidential to the extent permitted by law. See, *e.g.*, Conn. Gen. Stat. §1-210(b)(5)(A-B). The State, however, has no obligation to initiate, prosecute or defend any legal proceeding or to seek a protective order or other similar relief to prevent disclosure of any information that is sought pursuant to a FOIA request. Should the State withhold such documentation from a Freedom of Information requester and a complaint be brought to the Freedom of Information Commission, the Contractor shall have the burden of cooperating with DOT in defense of that action and in terms of establishing the availability of any FOIA exemption in any proceeding where it is an issue. In no event shall the State have any liability for the disclosure of any documents or information in its possession which the State believes are required to be disclosed pursuant to the FOIA or other law.

11. Service of Process

The Contractor, if not a resident of the State of Connecticut, or, in the case of a partnership, the partners, if not residents, hereby appoints the Secretary of State of the State of Connecticut, and his successors in office, as agent for service of process for any action arising out of or as a result of this Contract; such appointment to be in effect throughout the life of this Contract and six (6) years thereafter.

12. Substitution of Securities for Retainages on State Contracts and Subcontracts

This Contract is subject to the provisions of Section 3-112a of the General Statutes of the State of Connecticut, as revised.

13. Health Insurance Portability and Accountability Act of 1996 (HIPAA)

The Contractor shall comply, if applicable, with the Health Insurance Portability and Accountability Act of 1996 and, pursuant thereto, the provisions attached at Exhibit C, and hereby made part of this Contract.

14. Forum and Choice of Law

Forum and Choice of Law. The parties deem the Contract to have been made in the City of Hartford, State of Connecticut. Both parties agree that it is fair and reasonable for the validity and construction of the Contract to be, and it shall be, governed by the laws and court decisions of the State of Connecticut, without giving effect to its principles of conflicts of laws. To the extent that any immunities provided by Federal law or the laws of the State of Connecticut do not bar an action against the State, and to the extent that these courts are courts of competent jurisdiction, for the purpose of venue, the complaint shall be made returnable to the Judicial District of Hartford only or shall be brought in the United States District Court for the District of Connecticut only, and shall not be

transferred to any other court, provided, however, that nothing here constitutes a waiver or compromise of the sovereign immunity of the State of Connecticut. The Contractor waives any objection which it may now have or will have to the laying of venue of any Claims in any forum and further irrevocably submits to such jurisdiction in any suit, action or proceeding.

15. Summary of State Ethics Laws

Pursuant to the requirements of section 1-101qq of the Connecticut General Statutes, the summary of State ethics laws developed by the State Ethics Commission pursuant to section 1-81b of the Connecticut General Statutes is incorporated by reference into and made a part of the Contract as if the summary had been fully set forth in the Contract.

16. Audit and Inspection of Plants, Places of Business and Records

- (a) The State and its agents, including, but not limited to, the Connecticut Auditors of Public Accounts, Attorney General and State's Attorney and their respective agents, may, at reasonable hours, inspect and examine all of the parts of the Contractor's and Contractor Parties' plants and places of business which, in any way, are related to, or involved in, the performance of this Contract. For the purposes of this Section, "Contractor Parties" means the Contractor's members, directors, officers, shareholders, partners, managers, principal officers, representatives, agents, servants, consultants, employees or any one of them or any other person or entity with whom the Contractor is in privity of oral or written contract and the Contractor intends for such other person or entity to Perform under the Contract in any capacity.
- (b) The Contractor shall maintain, and shall require each of the Contractor Parties to maintain, accurate and complete Records. The Contractor shall make all of its and the Contractor Parties' Records available at all reasonable hours for audit and inspection by the State and its agents.
- (c) The State shall make all requests for any audit or inspection in writing and shall provide the Contractor with at least twenty-four (24) hours' notice prior to the requested audit and inspection date. If the State suspects fraud or other abuse, or in the event of an emergency, the State is not obligated to provide any prior notice.
- (d) The Contractor shall keep and preserve or cause to be kept and preserved all of its and Contractor Parties' Records until three (3) years after the latter of (i) final payment under this Agreement, or (ii) the expiration or earlier termination of this Agreement, as the same may be modified for any reason. The State may request an audit or inspection at any time during this period. If any Claim or audit is started before the expiration of this period, the Contractor shall retain or cause to be retained all Records until all Claims or audit findings have been resolved.
- (e) The Contractor shall cooperate fully with the State and its agents in connection with an audit or inspection. Following any audit or inspection, the State may conduct and the Contractor shall cooperate with an exit conference.
- (f) The Contractor shall incorporate this entire Section verbatim into any contract or other agreement that it enters into with any Contractor Party.

17. Campaign Contribution Restriction

For all State contracts, defined in Conn. Gen. Stat. §9-612(f)(1) as having a value in a calendar year of \$50,000 or more, or a combination or series of such agreements or contracts having a value of \$100,000 or more, the authorized signatory to this contract expressly acknowledges receipt of the State Elections Enforcement Commission's notice advising state contractors of state campaign contribution and solicitation prohibitions, and will inform its principals of the contents of the notice, as set forth in "Notice to Executive Branch State Contractors and Prospective State Contractors of Campaign Contribution and Solicitation Limitations," a copy of which is attached hereto and hereby made a part of this contract, attached as Exhibit D.

18. Tangible Personal Property

- (a) The Contractor on its behalf and on behalf of its Affiliates, as defined below, shall comply with the provisions of Conn. Gen. Stat. §12-411b, as follows:
- (1) For the term of the Contract, the Contractor and its Affiliates shall collect and remit to the State of Connecticut, Department of Revenue Services, any Connecticut use tax due under the provisions of Chapter 219 of the Connecticut General Statutes for items of tangible personal property sold by the Contractor or by any of its Affiliates in the same manner as if the Contractor and such Affiliates were engaged in the business of selling tangible personal property for use in Connecticut and had sufficient nexus under the provisions of Chapter 219 to be required to collect Connecticut use tax;
 - (2) A customer's payment of a use tax to the Contractor or its Affiliates relieves the customer of liability for the use tax;
 - (3) The Contractor and its Affiliates shall remit all use taxes they collect from customers on or before the due date specified in the Contract, which may not be later than the last day of the month next succeeding the end of a calendar quarter or other tax collection period during which the tax was collected;
 - (4) The Contractor and its Affiliates are not liable for use tax billed by them but not paid to them by a customer; and
 - (5) Any Contractor or Affiliate who fails to remit use taxes collected on behalf of its customers by the due date specified in the Contract shall be subject to the interest and penalties provided for persons required to collect sales tax under chapter 219 of the general statutes.
- (b) For purposes of this section of the Contract, the word "Affiliate" means any person, as defined in section 12-1 of the general statutes, that controls, is controlled by, or is under common control with another person. A person controls another person if the person owns, directly or indirectly, more than ten per cent of the voting securities of the other person. The word "voting security" means a security that confers upon the holder the right to vote for the election of members of the board of directors or similar governing body of the business, or that is convertible into, or entitles the holder to receive, upon its exercise, a security that confers such a right to vote. "Voting security" includes a general partnership interest.
- (c) The Contractor represents and warrants that each of its Affiliates has vested in the Contractor plenary authority to so bind the Affiliates in any agreement with the State of Connecticut. The Contractor on its own behalf and on behalf of its Affiliates shall also provide, no later than 30 days after receiving a request by the State's contracting authority, such information as the State may require to ensure, in the State's sole determination, compliance with the provisions of Chapter 219 of the Connecticut General Statutes, including, but not limited to, §12-411b.

19. Bid Rigging and/or Fraud – Notice to Contractor

The Connecticut Department of Transportation is cooperating with the U.S. Department of Transportation and the Justice Department in their investigation into highway construction contract bid rigging and/or fraud.

A toll-free "HOT LINE" telephone number 800-424-9071 has been established to receive information from contractors, subcontractors, manufacturers, suppliers or anyone with knowledge of bid rigging and/or fraud, either past or current. The "HOT LINE" telephone number will be available during normal working hours (8:00 am – 5:00 pm EST). Information will be treated confidentially and anonymity respected.

20. Consulting Agreement Affidavit

The Contractor shall comply with Connecticut General Statutes Section 4a-81(a) and 4a-81(b), as revised. Pursuant to Public Act 11-229, after the initial submission of the form, if there is a change in the information contained in the form, a contractor shall submit the updated form, as applicable, either (i) not later than thirty (30) days after the effective date of such change or (ii) prior to execution of any new contract, whichever is earlier.

The Affidavit/Form may be submitted in written format or electronic format through the Department of Administrative Services (DAS) website.

EXHIBIT A

TITLE VI CONTRACTOR ASSURANCES

During the performance of this Contract, the contractor, for itself, its assignees and successors in interest (hereinafter referred to as the "Contractor") agrees as follows:

1. Compliance with Regulations: The Contractor shall comply with the regulations relative to nondiscrimination in federally assisted programs of the United States Department of Transportation (hereinafter, "USDOT"), Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time (hereinafter referred to as the "Regulations"), which are herein incorporated by reference and made a part of this contract.

2. Nondiscrimination: The Contractor, with regard to the work performed by it during the Contract, shall not discriminate on the grounds of race, color, national origin, sex, age, or disability in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The Contractor shall not participate either directly or indirectly in the discrimination prohibited by Subsection 5 of the Regulations, including employment practices when the Contract covers a program set forth in Appendix B of the Regulations.

3. Solicitations for Subcontracts, Including Procurements of Materials and Equipment:

In all solicitations either by competitive bidding or negotiation made by the Contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the Contractor of the Contractor's obligations under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, national origin, sex, age, or disability.

4. Information and Reports: The Contractor shall provide all information and reports required by the Regulations or directives issued pursuant thereto and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Connecticut Department of Transportation (Conn DOT) or the Funding Agency (FHWA, FTA and FAA) to be pertinent to ascertain compliance with such Regulations, orders, and instructions. Where any information required of a Contractor is in the exclusive possession of another who fails or refuses to furnish this information, the Contractor shall so certify to Conn DOT or the Funding Agency, as appropriate, and shall set forth what efforts it has made to obtain the information.

5. Sanctions for Noncompliance: In the event of the Contractor's noncompliance with the nondiscrimination provisions of this Contract, the Conn DOT shall impose such sanctions as it or the Funding Agency may determine to be appropriate, including, but not limited to:

- A. Withholding contract payments until the Contractor is in-compliance; and/or
- B. Cancellation, termination, or suspension of the Contract, in whole or in part.

6. Incorporation of Provisions: The Contractor shall include the provisions of paragraphs 1 through 5 in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Regulations or directives issued pursuant thereto. The Contractor shall take such action with respect to any subcontract or procurement as the Conn DOT or the Funding Agency may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, however, that in the event a Contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the Contractor may request the Conn DOT to enter into such litigation to protect the interests of the Funding Agency, and, in addition, the Contractor may request the United States to enter into such litigation to protect the interests of the United States

EXHIBIT B**CONTRACTOR WORKFORCE UTILIZATION / EQUAL EMPLOYMENT OPPORTUNITY****1. Project Workforce Utilization Goals:**

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or Federally assisted or funded) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for the geographical area where the work is actually performed.

Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications which contain the applicable goals for minority and female participation.

The goals for minority and female utilization are expressed in percentage terms for the contractor's aggregate work-force in each trade on all construction work in the covered area, are referenced in the Appendix A below.

STATE FUNDED PROJECTS (only)
APPENDIX A
(Labor Market Goals)

LABOR MARKET AREA GOAL
Female

Minority

Bridgeport				22.7%
1.4%				
Ansonia	Beacon Falls	Bridgeport	Derby	
Easton	Fairfield	Milford	Monroe	
Oxford	Seymour	Shelton	Stratford	
Trumbull				
Danbury				10.7%
3.8%				
Bethel	Bridgewater	Brookfield	Danbury	
Kent	New Fairfield	New Milford	Newtown	
Redding	Ridgefield	Roxbury	Sherman	
Washington				
Danielson				4.3%
1.8%				
Brooklyn	Eastford	Hampton	Killingly	
Pomfret	Putnam	Scotland	Sterling	
Thompson	Voluntown	Union	Woodstock	
Hartford				13.7%
2.1%				
Andover	Ashford	Avon	Barkhamsted	

Belin	Bloomfield	Bolton	Bristol
Burlington	Canton	Chaplin	Colchester
Columbia	Coventry	Cromwell	Durham
East Granby	East Haddam	East Hampton	East Hartford
East Windsor	Ellington	Enfield	Farmington
Glastonbury	Granby	Haddam	Hartford
Harwinton	Hebron	Lebanon	Manchester
Mansfield	Marlborough	Middlefield	Middletown
Newington	Plainville	Plymouth	Portland
Rocky Hill	Simsbury	Somers	South Windsor
Southington	Stafford	Suffield	Tolland
Vernon	West Hartford	Wethersfield	Willington
Winchester	Windham	Windsor	Windsor Locks

Lower River 1.8%	4.3%
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Chester	Deep River	Essex	Old Lyme
Westbrook			

LABOR MARKET AREA GOAL
Female

Minority

New Haven 3.1%	17.9%
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Bethany	Branford	Cheshire	Clinton
East Haven	Guilford	Hamden	Killingworth
Madison	Meriden	New Haven	North Branford
North Haven	Orange	Wallingford	West Haven
Woodbridge			

New London 3.1%	7.4%
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Bozrah	Canterbury	East Lyme	Franklin
Griswold	Groton	Ledyard	Lisbon
Montville	New London	North Stonington	Norwich
Old Lyme	Old Saybrook	Plainfield	Preston
Salem	Sprague	Stonington	Waterford
Hopkinton	RI – Westerly Rhode Island		

Stamford 2.1%	33.2%
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Darien	Greenwich	New Canaan	Norwalk
Stamford	Weston	Westport	Wilton

Torrington 1.8%	4.3%
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Canaan	Colebrook	Cornwall	Goshen
Hartland	Kent	Litchfield	Morris
Norfolk	North Canaan	Salisbury	Sharon

April 2019

Torrington

Warren

Waterbury
1.6%

12.4%

Bethlehem
Southbury
Wolcott

Middlebury
Thomaston
Woodbury

Naugatuck
Waterbury

Prospect
Watertown

Rev. 4/24/2019

EXHIBIT C

Health Insurance Portability and Accountability Act of 1996 (“HIPAA”).

- (a) If the Contactor is a Business Associate under the requirements of the Health Insurance Portability and Accountability Act of 1996 (“HIPAA”), the Contractor must comply with all terms and conditions of this Section of the Contract. If the Contractor is not a Business Associate under HIPAA, this Section of the Contract does not apply to the Contractor for this Contract.
- (b) The Contractor is required to safeguard the use, publication and disclosure of information on all applicants for, and all clients who receive, services under the Contract in accordance with all applicable federal and state law regarding confidentiality, which includes but is not limited to HIPAA, more specifically with the Privacy and Security Rules at 45 C.F.R. Part 160 and Part 164, subparts A, C, and E; and
- (c) The State of Connecticut Agency named on page 1 of this Contract (hereinafter the “Department”) is a “covered entity” as that term is defined in 45 C.F.R. § 160.103; and
- (d) The Contractor, on behalf of the Department, performs functions that involve the use or disclosure of “individually identifiable health information,” as that term is defined in 45 C.F.R. § 160.103; and
- (e) The Contractor is a “business associate” of the Department, as that term is defined in 45 C.F.R. § 160.103; and
- (f) The Contractor and the Department agree to the following in order to secure compliance with the HIPAA, the requirements of Subtitle D of the Health Information Technology for Economic and Clinical Health Act (hereinafter the HITECH Act), (Pub. L. 111-5, sections 13400 to 13423), and more specifically with the Privacy and Security Rules at 45 C.F.R. Part 160 and Part 164, subparts A, C, and E.
- (g) Definitions
 - (1) “Breach shall have the same meaning as the term is defined in section 13400 of the HITECH Act (42 U.S.C. §17921(1))
 - (2) “Business Associate” shall mean the Contractor.
 - (3) “Covered Entity” shall mean the Department of the State of Connecticut named on page 1 of this Contract.
 - (4) “Designated Record Set” shall have the same meaning as the term “designated record set” in 45 C.F.R. § 164.501.
 - (5) “Electronic Health Record” shall have the same meaning as the term is defined in section 13400 of the HITECH Act (42 U.S.C. §17921(5))

- (6) "Individual" shall have the same meaning as the term "individual" in 45 C.F.R. § 160.103 and shall include a person who qualifies as a personal representative as defined in 45 C.F.R. § 164.502(g).
 - (7) "Privacy Rule" shall mean the Standards for Privacy of Individually Identifiable Health Information at 45 C.F.R. part 160 and parts 164, subparts A and E.
 - (8) "Protected Health Information" or "PHI" shall have the same meaning as the term "protected health information" in 45 C.F.R. § 160.103, limited to information created or received by the Business Associate from or on behalf of the Covered Entity.
 - (9) "Required by Law" shall have the same meaning as the term "required by law" in 45 C.F.R. § 164.103.
 - (10) "Secretary" shall mean the Secretary of the Department of Health and Human Services or his designee.
 - (11) "More stringent" shall have the same meaning as the term "more stringent" in 45 C.F.R. § 160.202.
 - (12) "This Section of the Contract" refers to the HIPAA Provisions stated herein, in their entirety.
 - (13) "Security Incident" shall have the same meaning as the term "security incident" in 45 C.F.R. § 164.304.
 - (14) "Security Rule" shall mean the Security Standards for the Protection of Electronic Protected Health Information at 45 C.F.R. part 160 and parts 164, subpart A and C.
 - (15) "Unsecured protected health information" shall have the same meaning as the term as defined in section 13402(h)(1)(A) of HITECH. Act. (42 U.S.C. §17932(h)(1)(A)).
- (h) Obligations and Activities of Business Associates.
- (1) Business Associate agrees not to use or disclose PHI other than as permitted or required by this Section of the Contract or as Required by Law.
 - (2) Business Associate agrees to use appropriate safeguards to prevent use or disclosure of PHI other than as provided for in this Section of the Contract.
 - (3) Business Associate agrees to use administrative, physical and technical safeguards that reasonably and appropriately protect the confidentiality, integrity, and availability of electronic protected health information that it creates, receives, maintains, or transmits on behalf of the Covered Entity.
 - (4) Business Associate agrees to mitigate, to the extent practicable, any harmful effect that is known to the Business Associate of a use or disclosure of PHI by Business Associate in violation of this Section of the Contract.

- (5) Business Associate agrees to report to Covered Entity any use or disclosure of PHI not provided for by this Section of the Contract or any security incident of which it becomes aware.
- (6) Business Associate agrees to insure that any agent, including a subcontractor, to whom it provides PHI received from, or created or received by Business Associate, on behalf of the Covered Entity, agrees to the same restrictions and conditions that apply through this Section of the Contract to Business Associate with respect to such information.
- (7) Business Associate agrees to provide access, at the request of the Covered Entity, and in the time and manner agreed to by the parties, to PHI in a Designated Record Set, to Covered Entity or, as directed by Covered Entity, to an Individual in order to meet the requirements under 45 C.F.R. § 164.524.
- (8) Business Associate agrees to make any amendments to PHI in a Designated Record Set that the Covered Entity directs or agrees to pursuant to 45 C.F.R. § 164.526 at the request of the Covered Entity, and in the time and manner agreed to by the parties.
- (9) Business Associate agrees to make internal practices, books, and records, including policies and procedures and PHI, relating to the use and disclosure of PHI received from, or created or received by, Business Associate on behalf of Covered Entity, available to Covered Entity or to the Secretary in a time and manner agreed to by the parties or designated by the Secretary, for purposes of the Secretary determining Covered Entity's compliance with the Privacy Rule.
- (10) Business Associate agrees to document such disclosures of PHI and information related to such disclosures as would be required for Covered Entity to respond to a request by an Individual for an accounting of disclosures of PHI in accordance with 45 C.F.R. § 164.528 and section 13405 of the HITECH Act (42 U.S.C. § 17935) and any regulations promulgated thereunder.
- (11) Business Associate agrees to provide to Covered Entity, in a time and manner agreed to by the parties, information collected in accordance with clause h. (10) of this Section of the Contract, to permit Covered Entity to respond to a request by an Individual for an accounting of disclosures of PHI in accordance with 45 C.F.R. § 164.528 and section 13405 of the HITECH Act (42 U.S.C. § 17935) and any regulations promulgated thereunder. Business Associate agrees at the Covered Entity's direction to provide an accounting of disclosures of PHI directly to an individual in accordance with 45 C.F.R. § 164.528 and section 13405 of the HITECH Act (42 U.S.C. § 17935) and any regulations promulgated thereunder.
- (12) Business Associate agrees to comply with any state or federal law that is more stringent than the Privacy Rule.
- (13) Business Associate agrees to comply with the requirements of the HITECH Act relating to privacy and security that are applicable to the Covered Entity and with the requirements of 45 C.F.R. sections 164.504(e), 164.308, 164.310, 164.312, and 164.316.

- (14) In the event that an individual requests that the Business Associate (a) restrict disclosures of PHI; (b) provide an accounting of disclosures of the individual's PHI; or (c) provide a copy of the individual's PHI in an electronic health record, the Business Associate agrees to notify the covered entity, in writing, within two business days of the request.
- (15) Business Associate agrees that it shall not, directly or indirectly, receive any remuneration in exchange for PHI of an individual without (1) the written approval of the covered entity, unless receipt of remuneration in exchange for PHI is expressly authorized by this Contract and (2) the valid authorization of the individual, except for the purposes provided under section 13405(d)(2) of the HITECH Act, (42 U.S.C. § 17935(d)(2)) and in any accompanying regulations

(16) Obligations in the Event of a Breach

- A. The Business Associate agrees that, following the discovery of a breach of unsecured protected health information, it shall notify the Covered Entity of such breach in accordance with the requirements of section 13402 of HITECH (42 U.S.C.17932(b) and the provisions of this Section of the Contract.
- B. Such notification shall be provided by the Business Associate to the Covered Entity without unreasonable delay, and in no case later than 30 days after the breach is discovered by the Business Associate, except as otherwise instructed in writing by a law enforcement official pursuant to section 13402 (g) of HITECH (42 U.S.C. 17932(g)). A breach is considered discovered as of the first day on which it is, or reasonably should have been, known to the Business Associate. The notification shall include the identification and last known address, phone number and email address of each individual (or the next of kin of the individual if the individual is deceased) whose unsecured protected health information has been, or is reasonably believed by the Business Associate to have been, accessed, acquired, or disclosed during such breach.
- C. The Business Associate agrees to include in the notification to the Covered Entity at least the following information:
1. A brief description of what happened, including the date of the breach and the date of the discovery of the breach, if known.
 2. A description of the types of unsecured protected health information that were involved in the breach (such as full name, Social Security number, date of birth, home address, account number, or disability code).
 3. The steps the Business Associate recommends that individuals take to protect themselves from potential harm resulting from the breach.
 4. A detailed description of what the Business Associate is doing to investigate the breach, to mitigate losses, and to protect against any further breaches.

5. Whether a law enforcement official has advised either verbally or in writing the Business Associate that he or she has determined that notification or notice to individuals or the posting required under section 13402 of the HITECH Act would impede a criminal investigation or cause damage to national security and; if so, include contact information for said official.
- D. Business Associate agrees to provide appropriate staffing and have established procedures to ensure that individuals informed by the Covered Entity of a breach by the Business Associate have the opportunity to ask questions and contact the Business Associate for additional information regarding the breach. Such procedures shall include a toll-free telephone number, an e-mail address, a posting on its Web site and a postal address. Business Associate agrees to include in the notification of a breach by the Business Associate to the Covered Entity, a written description of the procedures that have been established to meet these requirements. Costs of such contact procedures will be borne by the Contractor.
 - E. Business Associate agrees that, in the event of a breach, it has the burden to demonstrate that it has complied with all notifications requirements set forth above, including evidence demonstrating the necessity of a delay in notification to the Covered Entity.
- (i) Permitted Uses and Disclosure by Business Associate.
 - (1) General Use and Disclosure Provisions Except as otherwise limited in this Section of the Contract, Business Associate may use or disclose PHI to perform functions, activities, or services for, or on behalf of, Covered Entity as specified in this Contract, provided that such use or disclosure would not violate the Privacy Rule if done by Covered Entity or the minimum necessary policies and procedures of the Covered Entity.
 - (2) Specific Use and Disclosure Provisions
 - (A) Except as otherwise limited in this Section of the Contract, Business Associate may use PHI for the proper management and administration of Business Associate or to carry out the legal responsibilities of Business Associate.
 - (B) Except as otherwise limited in this Section of the Contract, Business Associate may disclose PHI for the proper management and administration of Business Associate, provided that disclosures are Required by Law, or Business Associate obtains reasonable assurances from the person to whom the information is disclosed that it will remain confidential and used or further disclosed only as Required by Law or for the purpose for which it was disclosed to the person, and the person notifies Business Associate of any instances of which it is aware in which the confidentiality of the information has been breached.
 - (C) Except as otherwise limited in this Section of the Contract, Business Associate may use PHI to provide Data Aggregation services to Covered Entity as permitted by 45 C.F.R. § 164.504(e)(2)(i)(B).

(j) Obligations of Covered Entity.

- (1) Covered Entity shall notify Business Associate of any limitations in its notice of privacy practices of Covered Entity, in accordance with 45 C.F.R. § 164.520, or to the extent that such limitation may affect Business Associate's use or disclosure of PHI.
- (2) Covered Entity shall notify Business Associate of any changes in, or revocation of, permission by Individual to use or disclose PHI, to the extent that such changes may affect Business Associate's use or disclosure of PHI.
- (3) Covered Entity shall notify Business Associate of any restriction to the use or disclosure of PHI that Covered Entity has agreed to in accordance with 45 C.F.R. § 164.522, to the extent that such restriction may affect Business Associate's use or disclosure of PHI.

(k) Permissible Requests by Covered Entity. Covered Entity shall not request Business Associate to use or disclose PHI in any manner that would not be permissible under the Privacy Rule if done by the Covered Entity, except that Business Associate may use and disclose PHI for data aggregation, and management and administrative activities of Business Associate, as permitted under this Section of the Contract.

(l) Term and Termination.

- (1) Term. The Term of this Section of the Contract shall be effective as of the date the Contract is effective and shall terminate when the information collected in accordance with clause h. (10) of this Section of the Contract is provided to the Covered Entity and all of the PHI provided by Covered Entity to Business Associate, or created or received by Business Associate on behalf of Covered Entity, is destroyed or returned to Covered Entity, or, if it is infeasible to return or destroy PHI, protections are extended to such information, in accordance with the termination provisions in this Section.
- (2) Termination for Cause Upon Covered Entity's knowledge of a material breach by Business Associate, Covered Entity shall either:
 - (A) Provide an opportunity for Business Associate to cure the breach or end the violation and terminate the Contract if Business Associate does not cure the breach or end the violation within the time specified by the Covered Entity; or
 - (B) Immediately terminate the Contract if Business Associate has breached a material term of this Section of the Contract and cure is not possible; or
 - (C) If neither termination nor cure is feasible, Covered Entity shall report the violation to the Secretary.

(3) Effect of Termination

(A) Except as provided in (1)(2) of this Section of the Contract, upon termination of this Contract, for any reason, Business Associate shall return or destroy all PHI received from Covered Entity, or created or received by Business Associate on behalf of Covered Entity. Business Associate shall also provide the information collected in accordance with clause h. (10) of this Section of the Contract to the Covered Entity within ten business days of the notice of termination. This provision shall apply to PHI that is in the possession of subcontractors or agents of Business Associate. Business Associate shall retain no copies of the PHI.

(B) In the event that Business Associate determines that returning or destroying the PHI is infeasible, Business Associate shall provide to Covered Entity notification of the conditions that make return or destruction infeasible. Upon documentation by Business Associate that return or destruction of PHI is infeasible, Business Associate shall extend the protections of this Section of the Contract to such PHI and limit further uses and disclosures of PHI to those purposes that make return or destruction infeasible, for as long as Business Associate maintains such PHI. Infeasibility of the return or destruction of PHI includes, but is not limited to, requirements under state or federal law that the Business Associate maintains or preserves the PHI or copies thereof.

(m) Miscellaneous Provisions.

- (1) Regulatory References. A reference in this Section of the Contract to a section in the Privacy Rule means the section as in effect or as amended.
- (2) Amendment. The Parties agree to take such action as is necessary to amend this Section of the Contract from time to time as is necessary for Covered Entity to comply with requirements of the Privacy Rule and the Health Insurance Portability and Accountability Act of 1996, Pub. L. No. 104-191.
- (3) Survival. The respective rights and obligations of Business Associate shall survive the termination of this Contract.
- (4) Effect on Contract. Except as specifically required to implement the purposes of this Section of the Contract, all other terms of the Contract shall remain in force and effect.
- (5) Construction. This Section of the Contract shall be construed as broadly as necessary to implement and comply with the Privacy Standard. Any ambiguity in this Section of the Contract shall be resolved in favor of a meaning that complies, and is consistent with, the Privacy Standard.

(6) Disclaimer. Covered Entity makes no warranty or representation that compliance with this Section of the Contract will be adequate or satisfactory for Business Associate's own purposes. Covered Entity shall not be liable to Business Associate for any claim, civil or criminal penalty, loss or damage related to or arising from the unauthorized use or disclosure of PHI by Business Associate or any of its officers, directors, employees, contractors or agents, or any third party to whom Business Associate has disclosed PHI contrary to the provisions of this Contract or applicable law. Business Associate is solely responsible for all decisions made, and actions taken, by Business Associate regarding the safeguarding, use and disclosure of PHI within its possession, custody or control.

(7) Indemnification. The Business Associate shall indemnify and hold the Covered Entity harmless from and against any and all claims, liabilities, judgments, fines, assessments, penalties, awards and any statutory damages that may be imposed or assessed pursuant to HIPAA, as amended or the HITECH Act, including, without limitation, attorney's fees, expert witness fees, costs of investigation, litigation or dispute resolution, and costs awarded thereunder, relating to or arising out of any violation by the Business Associate and its agents, including subcontractors, of any obligation of Business Associate and its agents, including subcontractors, under this section of the contract, under HIPAA, the HITECH Act, the Privacy Rule and the Security Rule.

Notice to Executive Branch State Contractors and Prospective State Contractors of Campaign Contribution and Solicitation Limitations

This notice is provided under the authority of Connecticut General Statutes §9-612(g)(2), as amended by P.A. 10-1, and is for the purpose of informing state contractors and prospective state contractors of the following law (*italicized words are defined on the reverse side of this page*).

CAMPAIGN CONTRIBUTION AND SOLICITATION LIMITATIONS

No *state contractor, prospective state contractor, principal of a state contractor or principal of a prospective state contractor*, with regard to a *state contract or state contract solicitation* with or from a state agency in the executive branch or a quasi-public agency or a holder, or principal of a holder of a valid prequalification certificate, shall make a contribution to (i) an exploratory committee or candidate committee established by a candidate for nomination or election to the office of Governor, Lieutenant Governor, Attorney General, State Comptroller, Secretary of the State or State Treasurer, (ii) a political committee authorized to make contributions or expenditures to or for the benefit of such candidates, or (iii) a party committee (which includes town committees).

In addition, no holder or principal of a holder of a valid prequalification certificate, shall make a contribution to (i) an exploratory committee or candidate committee established by a candidate for nomination or election to the office of State senator or State representative, (ii) a political committee authorized to make contributions or expenditures to or for the benefit of such candidates, or (iii) a party committee.

On and after January 1, 2011, no state contractor, prospective state contractor, principal of a state contractor or principal of a prospective state contractor, with regard to a state contract or state contract solicitation with or from a state agency in the executive branch or a quasi-public agency or a holder, or principal of a holder of a valid prequalification certificate, shall **knowingly solicit** contributions from the state contractor's or prospective state contractor's employees or from a *subcontractor or principals of the subcontractor* on behalf of (i) an exploratory committee or candidate committee established by a candidate for nomination or election to the office of Governor, Lieutenant Governor, Attorney General, State Comptroller, Secretary of the State or State Treasurer, (ii) a political committee authorized to make contributions or expenditures to or for the benefit of such candidates, or (iii) a party committee.

DUTY TO INFORM

State contractors and prospective state contractors are required to inform their principals of the above prohibitions, as applicable, and the possible penalties and other consequences of any violation thereof.

PENALTIES FOR VIOLATIONS

Contributions or solicitations of contributions made in violation of the above prohibitions may result in the following civil and criminal penalties:

Civil penalties—Up to \$2,000 or twice the amount of the prohibited contribution, whichever is greater, against a principal or a contractor. Any state contractor or prospective state contractor which fails to make reasonable efforts to comply with the provisions requiring notice to its principals of these prohibitions and the possible consequences of their violations may also be subject to civil penalties of up to \$2,000 or twice the amount of the prohibited contributions made by their principals.

Criminal penalties—Any knowing and willful violation of the prohibition is a Class D felony, which may subject the violator to imprisonment of not more than 5 years, or not more than \$5,000 in fines, or both.

CONTRACT CONSEQUENCES

In the case of a state contractor, contributions made or solicited in violation of the above prohibitions may result in the contract being voided.

In the case of a prospective state contractor, contributions made or solicited in violation of the above prohibitions shall result in the contract described in the state contract solicitation not being awarded to the prospective state contractor, unless the State Elections Enforcement Commission determines that mitigating circumstances exist concerning such violation.

The State shall not award any other state contract to anyone found in violation of the above prohibitions for a period of one year after the election for which such contribution is made or solicited, unless the State Elections Enforcement Commission determines that mitigating circumstances exist concerning such violation.

Additional information may be found on the website of the State Elections Enforcement Commission, www.ct.gov/seec. Click on the link to "Lobbyist/Contractor Limitations."

DEFINITIONS

“State contractor” means a person, business entity or nonprofit organization that enters into a state contract. Such person, business entity or nonprofit organization shall be deemed to be a state contractor until December thirty-first of the year in which such contract terminates. “State contractor” does not include a municipality or any other political subdivision of the state, including any entities or associations duly created by the municipality or political subdivision exclusively amongst themselves to further any purpose authorized by statute or charter, or an employee in the executive or legislative branch of state government or a quasi-public agency, whether in the classified or unclassified service and full or part-time, and only in such person's capacity as a state or quasi-public agency employee.

“Prospective state contractor” means a person, business entity or nonprofit organization that (i) submits a response to a state contract solicitation by the state, a state agency or a quasi-public agency, or a proposal in response to a request for proposals by the state, a state agency or a quasi-public agency, until the contract has been entered into, or (ii) holds a valid prequalification certificate issued by the Commissioner of Administrative Services under section 4a-100. “Prospective state contractor” does not include a municipality or any other political subdivision of the state, including any entities or associations duly created by the municipality or political subdivision exclusively amongst themselves to further any purpose authorized by statute or charter, or an employee in the executive or legislative branch of state government or a quasi-public agency, whether in the classified or unclassified service and full or part-time, and only in such person's capacity as a state or quasi-public agency employee.

“Principal of a state contractor or prospective state contractor” means (i) any individual who is a member of the board of directors of, or has an ownership interest of five per cent or more in, a state contractor or prospective state contractor, which is a business entity, except for an individual who is a member of the board of directors of a nonprofit organization, (ii) an individual who is employed by a state contractor or prospective state contractor, which is a business entity, as president, treasurer or executive vice president, (iii) an individual who is the chief executive officer of a state contractor or prospective state contractor, which is not a business entity, or if a state contractor or prospective state contractor has no such officer, then the officer who duly possesses comparable powers and duties, (iv) an officer or an employee of any state contractor or prospective state contractor who has *managerial or discretionary responsibilities with respect to a state contract*, (v) the spouse or a *dependent child* who is eighteen years of age or older of an individual described in this subparagraph, or (vi) a political committee established or controlled by an individual described in this subparagraph or the business entity or nonprofit organization that is the state contractor or prospective state contractor.

“State contract” means an agreement or contract with the state or any state agency or any quasi-public agency, let through a procurement process or otherwise, having a value of fifty thousand dollars or more, or a combination or series of such agreements or contracts having a value of one hundred thousand dollars or more in a calendar year, for (i) the rendition of services, (ii) the furnishing of any goods, material, supplies, equipment or any items of any kind, (iii) the construction, alteration or repair of any public building or public work, (iv) the acquisition, sale or lease of any land or building, (v) a licensing arrangement, or (vi) a grant, loan or loan guarantee. “State contract” does not include any agreement or contract with the state, any state agency or any quasi-public agency that is exclusively federally funded, an education loan, a loan to an individual for other than commercial purposes or any agreement or contract between the state or any state agency and the United States Department of the Navy or the United States Department of Defense.

“State contract solicitation” means a request by a state agency or quasi-public agency, in whatever form issued, including, but not limited to, an invitation to bid, request for proposals, request for information or request for quotes, inviting bids, quotes or other types of submittals, through a competitive procurement process or another process authorized by law waiving competitive procurement.

“Managerial or discretionary responsibilities with respect to a state contract” means having direct, extensive and substantive responsibilities with respect to the negotiation of the state contract and not peripheral, clerical or ministerial responsibilities.

“Dependent child” means a child residing in an individual's household who may legally be claimed as a dependent on the federal income tax of such individual.

“Solicit” means (A) requesting that a contribution be made, (B) participating in any fund-raising activities for a candidate committee, exploratory committee, political committee or party committee, including, but not limited to, forwarding tickets to potential contributors, receiving contributions for transmission to any such committee or bundling contributions, (C) serving as chairperson, treasurer or deputy treasurer of any such committee, or (D) establishing a political committee for the sole purpose of soliciting or receiving contributions for any committee. Solicit does not include: (i) making a contribution that is otherwise permitted by Chapter 155 of the Connecticut General Statutes; (ii) informing any person of a position taken by a candidate for public office or a public official, (iii) notifying the person of any activities of, or contact information for, any candidate for public office; or (iv) serving as a member in any party committee or as an officer of such committee that is not otherwise prohibited in this section.

“Subcontractor” means any person, business entity or nonprofit organization that contracts to perform part or all of the obligations of a state contractor's state contract. Such person, business entity or nonprofit organization shall be deemed to be a subcontractor until December thirty first of the year in which the subcontract terminates. “Subcontractor” does not include (i) a municipality or any other political subdivision of the state, including any entities or associations duly created by the municipality or political subdivision exclusively amongst themselves to further any purpose authorized by statute or charter, or (ii) an employee in the executive or legislative branch of state government or a quasi-public agency, whether in the classified or unclassified service and full or part-time, and only in such person's capacity as a state or quasi-public agency employee.

“Principal of a subcontractor” means (i) any individual who is a member of the board of directors of, or has an ownership interest of five per cent or more in, a subcontractor, which is a business entity, except for an individual who is a member of the board of directors of a nonprofit organization, (ii) an individual who is employed by a subcontractor, which is a business entity, as president, treasurer or executive vice president, (iii) an individual who is the chief executive officer of a subcontractor, which is not a business entity, or if a subcontractor has no such officer, then the officer who duly possesses comparable powers and duties, (iv) an officer or an employee of any subcontractor who has managerial or discretionary responsibilities with respect to a subcontract with a state contractor, (v) the spouse or a dependent child who is eighteen years of age or older of an individual described in this subparagraph, or (vi) a political committee established or controlled by an individual described in this subparagraph or the business entity or nonprofit organization that is the subcontractor.

EXHIBIT E

(state wages will be inserted here)

Informational Bulletin

THE 10-HOUR OSHA CONSTRUCTION SAFETY AND HEALTH COURSE

(applicable to public building contracts entered into *on or after July 1, 2007*, where the total cost of all work to be performed is at least \$100,000)

- (1) This requirement was created by Public Act No. 06-175, which is codified in Section 31-53b of the Connecticut General Statutes (pertaining to the prevailing wage statutes);
- (2) The course is required for public building construction contracts (projects funded in whole or in part by the state or any political subdivision of the state) entered into on or after July 1, 2007;
- (3) It is required of private employees (not state or municipal employees) and apprentices who perform manual labor for a general contractor or subcontractor on a public building project where the total cost of all work to be performed is at least \$100,000;
- (4) The ten-hour construction course pertains to the ten-hour Outreach Course conducted in accordance with federal OSHA Training Institute standards, and, for telecommunications workers, a ten-hour training course conducted in accordance with federal OSHA standard, 29 CFR 1910.268;
- (5) The internet website for the federal OSHA Training Institute is http://www.osha.gov/fso/ote/training/edcenters/fact_sheet.html;

- (6) The statutory language leaves it to the contractor and its employees to determine who pays for the cost of the ten-hour Outreach Course;
- (7) Within 30 days of receiving a contract award, a general contractor must furnish proof to the Labor Commissioner that all employees and apprentices performing manual labor on the project will have completed such a course;
- (8) Proof of completion may be demonstrated through either: (a) the presentation of a *bona fide* student course completion card issued by the federal OSHA Training Institute; or (2) the presentation of documentation provided to an employee by a trainer certified by the Institute pending the actual issuance of the completion card;
- (9) Any card with an issuance date more than 5 years prior to the commencement date of the construction project shall not constitute proof of compliance;
- (10) Each employer shall affix a copy of the construction safety course completion card to the certified payroll submitted to the contracting agency in accordance with Conn. Gen. Stat. § 31-53(f) on which such employee's name first appears;
- (11) Any employee found to be in non-compliance shall be subject to removal from the worksite if such employee does not provide satisfactory proof of course completion to the Labor Commissioner by the fifteenth day after the date the employee is determined to be in noncompliance;
- (12) Any such employee who is determined to be in noncompliance may continue to work on a public building construction project for a maximum of fourteen consecutive calendar days while bringing his or her status into compliance;
- (13) The Labor Commissioner may make complaint to the prosecuting authorities regarding any employer or agent of the employer, or officer or agent of the corporation who files a false certified payroll with respect to the status of an employee who is performing manual labor on a public building construction project;
- (14) The statute provides the minimum standards required for the completion of a safety course by manual laborers on public construction contracts; any contractor can exceed these minimum requirements; and
- (15) Regulations clarifying the statute are currently in the regulatory process, and shall be posted on the CTDOL website as soon as they are adopted in final form.

- (16) Any questions regarding this statute may be directed to the Wage and Workplace Standards Division of the Connecticut Labor Department via the internet website of <http://www.ctdol.state.ct.us/wgwkstnd/wgemenu.htm>; or by telephone at (860)263-6790.

THE ABOVE INFORMATION IS PROVIDED EXCLUSIVELY AS AN EDUCATIONAL RESOURCE, AND IS NOT INTENDED AS A SUBSTITUTE FOR LEGAL INTERPRETATIONS WHICH MAY ULTIMATELY ARISE CONCERNING THE CONSTRUCTION OF THE STATUTE OR THE REGULATIONS.

November 29, 2006

Notice
To All Mason Contractors and Interested Parties
Regarding Construction Pursuant to Section 31-53 of the
Connecticut General Statutes (Prevailing Wage)

The Connecticut Labor Department Wage and Workplace Standards Division is empowered to enforce the prevailing wage rates on projects covered by the above referenced statute.

Over the past few years the Division has withheld enforcement of the rate in effect for workers who operate a forklift on a prevailing wage rate project due to a potential jurisdictional dispute.

The rate listed in the schedules and in our Occupational Bulletin (see enclosed) has been as follows:

Forklift Operator:

- **Laborers (Group 4) Mason Tenders** - operates forklift solely to assist a mason to a maximum height of nine feet only.

- **Power Equipment Operator (Group 9)** - operates forklift to assist any trade and to assist a mason to a height over nine feet.

The U.S. Labor Department conducted a survey of rates in Connecticut but it has not been published and the rate in effect remains as outlined in the above Occupational Bulletin.

Since this is a classification matter and not one of jurisdiction, effective January 1, 2007 the Connecticut Labor Department will enforce the rate on each schedule in accordance with our statutory authority.

Your cooperation in filing appropriate and accurate certified payrolls is appreciated.

STATUTE 31-55a

- SPECIAL NOTICE -

To: All State and Political Subdivisions, Their Agents, and Contractors

Connecticut General Statute 31-55a - Annual adjustments to wage rates by contractors doing state work.

Each contractor that is awarded a contract on or after October 1, 2002, for (1) the construction of a state highway or bridge that falls under the provisions of section 31-54 of the general statutes, or (2) the construction, remodeling, refinishing, refurbishing, rehabilitation, alteration or repair of any public works project that falls under the provisions of section 31-53 of the general statutes shall contact the Labor Commissioner on or before July first of each year, for the duration of such contract, to ascertain the prevailing rate of wages on an hourly basis and the amount of payment or contributions paid or payable on behalf of each mechanic, laborer or worker employed upon the work contracted to be done, and shall make any necessary adjustments to such prevailing rate of wages and such payment or contributions paid or payable on behalf of each such employee, effective each July first.

- The prevailing wage rates applicable to any contract or subcontract awarded on or after October 1, 2002 are subject to annual adjustments each July 1st for the duration of any project which was originally advertised for bids on or after October 1, 2002.
- Each contractor affected by the above requirement shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.
- It is the *contractor's* responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's Web Site. The annual adjustments will be posted on the Department of Labor Web page: www.ctdol.state.ct.us. For those without internet access, please contact the division listed below.
- The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project. All subsequent annual adjustments will be posted on our Web Site for contractor access.

Any questions should be directed to the Contract Compliance Unit, Wage and Workplace Standards Division, Connecticut Department of Labor, 200 Folly Brook Blvd., Wethersfield, CT 06109 at (860)263-6790.

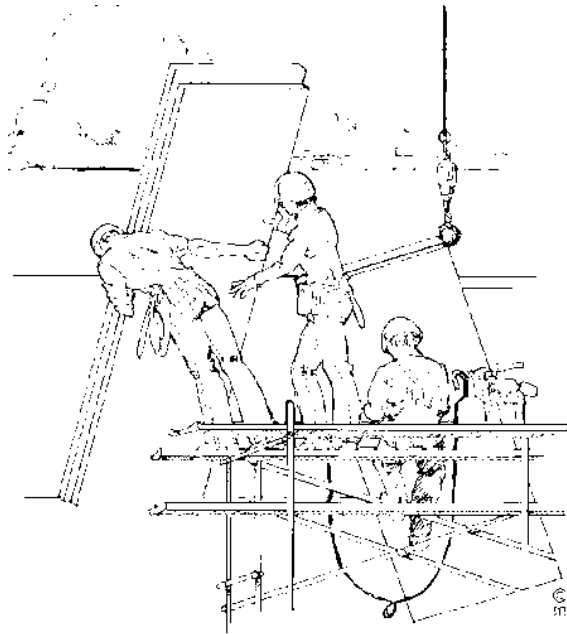
~ NOTICE ~

TO ALL CONTRACTING AGENCIES

Please be advised that Connecticut General Statutes Section 31-53, requires the contracting agency to certify to the Department of Labor, the total dollar amount of work to be done in connection with such public works project, regardless of whether such project consists of one or more contracts.

Please find the attached "Contracting Agency Certification Form" to be completed and returned to the Department of Labor, Wage and Workplace Standards Division, Public Contract Compliance Unit.

0 Inquiries can be directed to (860)263-6543.



**CONNECTICUT DEPARTMENT OF LABOR
WAGE AND WORKPLACE STANDARDS DIVISION
CONTRACT COMPLIANCE UNIT**

CONTRACTING AGENCY CERTIFICATION FORM

I, _____, acting in my official capacity as _____,
authorized representative title

for _____, located at _____,
contracting agency address

do hereby certify that the total dollar amount of work to be done in connection with

_____, located at _____,
project name and number address

shall be \$ _____, which includes all work, regardless of whether such project
consists of one or more contracts.

CONTRACTOR INFORMATION

Name: _____

Address: _____

Authorized Representative: _____

Approximate Starting Date: _____

Approximate Completion Date: _____

Signature

Date

Return to: Connecticut Department of Labor
Wage & Workplace Standards Division
Contract Compliance Unit
200 Folly Brook Blvd.
Wethersfield, CT 06109

Date Issued: _____

CONNECTICUT DEPARTMENT OF LABOR
WAGE AND WORKPLACE STANDARDS DIVISION

CONTRACTORS WAGE CERTIFICATION FORM
Construction Manager at Risk/General Contractor/Prime Contractor

I, _____ of _____
Officer, Owner, Authorized Rep. Company Name

do hereby certify that the _____
Company Name

Street

City

and all of its subcontractors will pay all workers on the

Project Name and Number

Street and City

the wages as listed in the schedule of prevailing rates required for such project (a copy of which is attached hereto).

Signed

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

Notary Public

Return to:

Connecticut Department of Labor
Wage & Workplace Standards Division
200 Folly Brook Blvd.
Wethersfield, CT 06109

Rate Schedule Issued (Date): _____

[New] In accordance with Section 31-53b(a) of the C.G.S. each contractor shall provide a copy of the OSHA 10 Hour Construction Safety and Health Card for each employee, to be attached to the first certified payroll on the project.

In accordance with Connecticut General Statutes, 31-53 Certified Payrolls with a statement of compliance shall be submitted monthly to the contracting agency.												PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS										Connecticut Department of Labor Wage and Workplace Standards Division 200 Folly Brook Blvd. Wethersfield, CT 06109					
CONTRACTOR NAME AND ADDRESS:												SUBCONTRACTOR NAME & ADDRESS						WORKER'S COMPENSATION INSURANCE CARRIER POLICY # EFFECTIVE DATE: EXPIRATION DATE:									
PAYROLL NUMBER		Week-Ending Date		PROJECT NAME & ADDRESS																							
PERSON/WORKER, ADDRESS and SECTION		APPR RATE %	MALE/ FEMALE AND RACE*	WORK CLASSIFICATION		DAY AND DATE					Total ST Hours	BASE HOURLY RATE	TYPE OF FRINGE BENEFITS Per Hour 1 through 6 (see back)	GROSS PAY FOR ALL WORK PERFORMED THIS WEEK	TOTAL DEDUCTIONS				GROSS PAY FOR THIS PREVAILING RATE JOB	CHECK # AND NET PAY							
						S	M	T	W	TH	F				S	FICA	FEDERAL	STATE			LIST OTHER						
				Trade License Type & Number - OSHA 10 Certification Number										Total O/T Hours	TOTAL FRINGE BENEFIT PLAN CASH												
												\$ Base Rate	1. \$ 2. \$ 3. \$														
												\$ Cash Fringe	4. \$ 5. \$ 6. \$														
												\$ Base Rate	1. \$ 2. \$ 3. \$														
												\$ Cash Fringe	4. \$ 5. \$ 6. \$														
												\$ Base Rate	1. \$ 2. \$ 3. \$														
												\$ Cash Fringe	4. \$ 5. \$ 6. \$														
												\$ Base Rate	1. \$ 2. \$ 3. \$														
												\$ Cash Fringe	4. \$ 5. \$ 6. \$														
12/9/2013		*IF REQUIRED										*SEE REVERSE SIDE										PAGE NUMBER ____ OF					
WWS-CP1																											

***FRINGE BENEFITS EXPLANATION (P):**

Bona fide benefits paid to approved plans, funds or programs, except those required by Federal or State Law (unemployment tax, worker’s compensation, income taxes, etc.).

Please specify the type of benefits provided:

- 1) Medical or hospital care_____
- 4) Disability_____
- 2) Pension or retirement_____
- 5) Vacation, holiday_____
- 3) Life Insurance_____
- 6) Other (please specify) _____

CERTIFIED STATEMENT OF COMPLIANCE

For the week ending date of_____,

I,_____ of _____, (hereafter known as

Employer) in my capacity as _____(title) do hereby certify and state:

Section A:

1. All persons employed on said project have been paid the full weekly wages earned by them during the week in accordance with Connecticut General Statutes, section 31-53, as amended. Further, I hereby certify and state the following:

a) The records submitted are true and accurate;

b) The rate of wages paid to each mechanic, laborer or workman and the amount of payment or contributions paid or payable on behalf of each such person to any employee welfare fund, as defined in Connecticut General Statutes, section 31-53 (h), are not less than the prevailing rate of wages and the amount of payment or contributions paid or payable on behalf of each such person to any employee welfare fund, as determined by the Labor Commissioner pursuant to subsection Connecticut General Statutes, section 31-53 (d), and said wages and benefits are not less than those which may also be required by contract;

c) The Employer has complied with all of the provisions in Connecticut General Statutes, section 31-53 (and Section 31-54 if applicable for state highway construction);

d) Each such person is covered by a worker’s compensation insurance policy for the duration of his employment which proof of coverage has been provided to the contracting agency;

e) The Employer does not receive kickbacks, which means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided directly or indirectly, to any prime contractor, prime contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contractor in connection with a prime contractor in connection with a subcontractor relating to a prime contractor; and

f) The Employer is aware that filing a certified payroll which he knows to be false is a class D felony for which the employer may be fined up to five thousand dollars, imprisoned for up to five years or both.

2. OSHA~The employer shall affix a copy of the construction safety course, program or training completion document to the certified payroll required to be submitted to the contracting agency for this project on which such persons’ name first appears.

(Signature)

(Title)

Submitted on (Date)

Weekly Payroll Certification For Public Works Projects (Continued)				<u>PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS</u>										Week-Ending Date: Contractor or Subcontractor Business Name:						
WEEKLY PAYROLL																				
PERSON/WORKER, ADDRESS and SECTION	APPR RATE %	MALE/ FEMALE AND RACE*	WORK CLASSIFICATION	DAY AND DATE						Total ST Hours	BASE HOURLY RATE	TYPE OF FRINGE BENEFITS Per Hour 1 through 6 (see back)	GROSS PAY FOR ALL WORK PERFORMED THIS WEEK	TOTAL DEDUCTIONS				GROSS PAY FOR THIS PREVAILING RATE JOB	CHECK # AND NET PAY	
				S	M	T	W	TH	F	S					FICA	FEDERAL	STATE			LIST OTHER
			Trade License Type & Number - OSHA							Total O/T Hours	TOTAL FRINGE BENEFIT PLAN									
			10 Certification Number	HOURS WORKED EACH DAY							CASH									
																		\$ Base Rate	1. \$	
																			2. \$	
																			3. \$	
																		\$ Cash Fringe	4. \$	
																			5. \$	
6. \$																				
																		\$ Base Rate	1. \$	
																			2. \$	
																			3. \$	
																		\$ Cash Fringe	4. \$	
																			5. \$	
6. \$																				
																		\$ Base Rate	1. \$	
																			2. \$	
																			3. \$	
																		\$ Cash Fringe	4. \$	
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																		\$ Base Rate	1. \$	
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																		\$ Cash Fringe	4. \$	
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6. \$																				
																		\$ Base Rate	1. \$	
																			2. \$	
																			3. \$	
																		\$ Cash Fringe	4. \$	
																			5. \$	
6. \$																				
																		\$ Base Rate	1. \$	
																			2. \$	
																			3. \$	
																		\$ Cash Fringe	4. \$	
																			5. \$	
6. \$																				

12/9/2013
WWS-CP2

*IF REQUIRED

NOTICE: THIS PAGE MUST BE ACCOMPANIED BY A COVER PAGE (FORM # WWS-CP1)

PAGE NUMBER ____ OF

[New] In accordance with Section 31-53b(a) of the C.G.S. each contractor shall provide a copy of the OSHA 10 Hour Construction Safety and Health Card for each employee, to be attached to the first certified payroll on the project.

In accordance with Connecticut General Statute, 31-53 Certified Payroll, with a statement of compliance Shall be submitted monthly to the contracting agency.										PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS WEEKLY PAYROLL										Connecticut Department of Labor Wage and Workplace Standard, Division 200 Folly Brook Blvd. Wethersfield, CT 06109														
CONTRACTOR NAME AND ADDRESS: Landon Corporation, 15 Connecticut Avenue, Northford, CT 06472															SUBCONTRACTOR NAME & ADDRESS XYZ Corporation 2 Main Street Yantic, CT 06389										WORKER'S COMPENSATION INSURANCE CARRIER Traveler, Insurance Company POLICY# #BAC8888928 EFFECTIVE DATE: 11/1/09 EXPIRATION DATE: 12/31/09									
PAYROLL NUMBER 1		Week-Ending Date 9/12/09		PROJECT NAME & ADDRESS DOT 105-296, Route 82																														
PERSON/WORKER, ADDRESS and SECTION		APPROPRIATE RATE 1/4	MALE/ FEMALE AND RACE	WORK CLASSIFICATION		DAY AND DATE						Total Hours	BASE HOURLY RATE	TYPE OF FRINGE BENEFITS Per Hour 1 through 6 (see back)	GROSS PAY FOR ALL WORK PERFORMED THIS WEEK	TOTAL DEDUCTIONS				GROSS PAY FOR THIS PREVAILING RATE JOB	CHECK#AND NET PAY													
						\$	M	T	W	TH	F					S	FICA	FEDERAL	STATE			LIST OTHER.												
				Trade License Type & Number- OSHA 10 Certification Number		20	21	22	23	24	25	26	Total Off Hours	TOTAL FRINGE BENEFIT PLAN CASH																				
Robert Craft 81 Maple Street Willimantic, CT 06226			MIC	Electrical Lineman E-1 1234567 Owner OSHA 12:1456			8		8	8	8	8		S-TIME	\$ 30.75	1. \$ 5.60	\$1,582.80				P-xxxx	\$1,582.80	#123 \$ xxx.xx											
														40	Base Rate	2. \$																		
														0-TIME	\$ 8.82	4. \$																		
															Cash Fringe	5. \$																		
																6. \$																		
Ronald Jones 212 Elm Street Norwich, CT 06360		65%	MIB	Electrical Apprentice * OSHA2:14567			8	8	8	8	8	8		S-TIME	\$ 19.99	1. \$	\$1,464.80	xx.xx	)0(x.xx	xx.xx	G-xxx	\$1,464.80	#124 \$xxx.xx											
														40	Base Rate	2. \$																		
														0-TIME	\$ 16.63	4. \$																		
															Cash Fringe	5. \$																		
																6. \$																		
Franklin T. Smith 234 Washington Rd. New London, CT 06320 SECTION B			M/H	Project Manager										S-TIME	\$	1. \$	\$1,500.00	xx.xx	xx.xx	xx.xx	M-xxx		#125)00(xxx											
														6	Base Rate	2. \$																		
														0-TIME	\$	4. \$																		
															Cash Fringe	5. \$																		
																6. \$																		
														S-TIME	\$	1. \$																		
															Base Rate	2. \$																		
														0-TIME	\$	4. \$																		
															Cash Fringe	5. \$																		
																6. \$																		

7/13 / 2009
WWS-CPt

IF REQUIRED

SEE REVERSE SIDE

PAGE NUMBER 1 OF 1

***FRINGE BENEFITS EXPLANATION (P):**

Bona fide benefits paid to approved plans, funds or programs, except those required by Federal or State Law (unemployment tax, worker's compensation, income taxes, etc.).

Please specify the type of benefits provided:

- 1) Medical or hospital care etc. ~~Disability~~ _____
2) Pension or retirement _____ 5) Vacation, holiday _____
~~Life insurance~~ Utopia _____ 6) Other (please specify) _ _ _ _ _

CERTIFIED STATEMENT OF COMPLIANCE

For the week ending date of 9/26/09 _____

I, Robert Craft
of XYZ Corporation (hereafter known as Employer) in my capacity as owner
(title) do hereby certify and state:

Section A:

I. All persons employed on said project have been paid the full weekly wages earned by them during the week in accordance with Connecticut General Statutes, section 31-53, as amended. Further, I hereby certify and state the following:

- a) The records submitted are true and accurate;
- b) The rate of wages paid to each mechanic, laborer or workman and the amount of payment or contributions paid or payable on behalf of each such employee to any employee welfare fund, as defined in Connecticut General Statutes, section 31-53 (h), are not less than the prevailing rate of wages and the amount of payment or contributions paid or payable on behalf of each such employee to any employee welfare fund, as determined by the Labor Commissioner pursuant to subsection Connecticut General Statutes, section 31-53 (d), and said wages and benefits are not less than those which may also be required by contract;
- c) The Employer has complied with all of the provisions in Connecticut General Statutes, section 31-53 (and Section 31-54 if applicable for state highway construction);
- d) Each such employee of the Employer is covered by a worker's compensation insurance policy for the duration of his employment which proof of coverage has been provided to the contracting agency;
- e) The Employer does not receive kickbacks, which means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided directly or indirectly, to any prime contractor, prime contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contractor in connection with a prime contractor in connection with a subcontractor relating to a prime contractor; and
- f) The Employer is aware that filing a certified payroll which he knows to be false is a class D felony for which the employer may be fined up to five thousand dollars, imprisoned for up to five years or both.

2. OSHA - The employer shall affix a copy of the construction safety course, program or training completion document to the certified payroll required to be submitted to the contracting agency for this project on which such employee's name first appears.

Y _____ 10/2/09

Submitted on (Date)

Section B: Applies to CONNDOT Projects ONLY

That pursuant to CONNDOT contract requirements for reporting purposes only, all employees listed under Section B who performed work on this project are not covered under the prevailing

nael _____ 10/2/09
(Signature) (Title) Submitted on (Date)

Note: CTDOL will assume all hours worked were performed under Section A unless clearly delineated as Section B WWS-CP! as such. Should an employee perform work under both Section A and Section B, the hours worked and wages paid must be segregated for reporting purposes.

THIS IS A PUBLIC DOCUMENT
*****DO NOT INCLUDE SOCIAL SECURITY NUMBERS***

Information Bulletin

Occupational Classifications

The Connecticut Department of Labor has the responsibility to properly determine "*job classification*" on prevailing wage projects covered under C.G.S. Section 31-53(d).

Note: This information is intended to provide a sample of some occupational classifications for guidance purposes only. It is not an all-inclusive list of each occupation's duties. This list is being provided only to highlight some areas where a contractor may be unclear regarding the proper classification. If unsure, the employer should seek guidelines for CTDOL.

Below are additional clarifications of specific job duties performed for certain classifications:

- ASBESTOS WORKERS

Applies all insulating materials, protective coverings, coatings and finishes to all types of mechanical systems.

- ASBESTOS INSULATOR

Handle, install apply, fabricate, distribute, prepare, alter, repair, dismantle, heat and frost insulation, including penetration and fire stopping work on all penetration fire stop systems.

- BOILERMAKERS

Erects hydro plants, incomplete vessels, steel stacks, storage tanks for water, fuel, etc. Builds incomplete boilers, repairs heat exchanges and steam generators.

- BRICKLAYERS, CEMENT MASONS, CEMENT FINISHERS, MARBLE MASONS, PLASTERERS, STONE MASONS, PLASTERERS. STONE MASONS, TERRAZZO WORKERS, TILE SETTERS

Lays building materials such as brick, structural tile and concrete cinder, glass, gypsum, terra cotta block. Cuts, tools and sets marble, sets stone, finishes concrete, applies decorative steel, aluminum and plastic tile, applies cements, sand, pigment and marble chips to floors, stairways, etc.

- CARPENTERS, MILLWRIGHTS, PILEDRIVERMEN, LATHERS, RESILIENT FLOOR LAYERS, DOCK BUILDERS, DIKERS, DIVER TENDERS

Constructs, erects, installs and repairs structures and fixtures of wood, plywood and wallboard. Installs, assembles, dismantles, moves industrial machinery. Drives piling into ground to provide foundations for structures such as buildings and bridges, retaining walls for earth embankments, such as cofferdams. Fastens wooden, metal or rock board lath to walls, ceilings and partitions of buildings, acoustical tile layer, concrete form builder. Applies fire stopping materials on fire resistive joint systems only. Installation of curtain/window walls only where attached to wood or metal studs. Installation of insulated material of all types whether blown, nailed or attached in other ways to walls, ceilings and floors of buildings. Assembly and installation of modular furniture/furniture systems. Free-standing furniture is not covered. This includes free standing: student chairs, study top desks, book box desks, computer furniture, dictionary stand, atlas stand, wood shelving, two-position information access station, file cabinets, storage cabinets, tables, etc.

- LABORER, CLEANING

- The cleanup of any construction debris and the general (heavy/light) cleaning, including sweeping, wash down, mopping, wiping of the construction facility and its furniture, washing, polishing, and dusting.

- DELIVERY PERSONNEL

- If delivery of supplies/building materials is to one common point and stockpiled there, prevailing wages are not required. If the delivery personnel are involved in the distribution of the material to multiple locations within the construction site then they would have to be paid prevailing wages for the type of work performed: laborer, equipment operator, electrician, ironworker, plumber, etc.

- An example of this would be where delivery of drywall is made to a building and the delivery personnel distribute the drywall from one "stockpile" location to further sub-locations on each floor. Distribution of material around a construction site is the job of a laborer or tradesman, and not delivery personnel.

- ELECTRICIANS

Install, erect, maintenance, alteration or repair of any wire, cable, conduit, etc., which generates, transforms, transmits or uses electrical energy for light, heat, power or other purposes, including the installation or maintenance of telecommunication, LAN wiring or computer equipment, and low voltage wiring. **License required per Connecticut General Statutes: E-1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9.*

- ELEVATOR CONSTRUCTORS

Install, erect, maintenance and repair of all types of elevators, escalators, dumb waiters and moving walks. **License required by Connecticut General Statutes: R-1,2,5,6.*

- FORK LIFT OPERATOR

Laborers Group 4) Mason Tenders - operates forklift solely to assist a mason to a maximum height of nine (9) feet only.

Power Equipment Operator Group 9 - operates forklift to assist any trade, and to assist a mason to a height over nine (9) feet.

- GLAZIERS

Glazing wood and metal sash, doors, partitions, and 2 story aluminum storefronts. Installs glass windows, skylights, store fronts and display cases or surfaces such as building fronts, interior walls, ceilings and table tops and metal store fronts. Installation of aluminum window walls and curtain walls is the "joint" work of glaziers and ironworkers, which require equal composite workforce.

- IRONWORKERS

Erection, installation and placement of structural steel, precast concrete, miscellaneous iron, ornamental iron, metal curtain wall, rigging and reinforcing steel. Handling, sorting, and installation of reinforcing steel (rebar). Metal bridge rail (traffic), metal bridge handrail, and decorative security fence installation. Installation of aluminum window walls and curtain walls is the "joint" work of glaziers and ironworkers which require equal composite workforce.

- INSULATOR

- Installing fire stopping systems/materials for "Penetration Firestop Systems": transit to cables, electrical conduits, insulated pipes, sprinkler pipe penetrations, ductwork behind radiation, electrical cable trays, fire rated pipe penetrations, natural polypropylene, HVAC ducts, plumbing bare metal, telephone and communication wires, and boiler room ceilings.

- LABORERS

Acetylene burners, asphalt rakers, chain saw operators, concrete and power buggy operator, concrete saw operator, fence and guard rail erector (except metal bridge rail (traffic), decorative security fence (non-metal).

installation.), hand operated concrete vibrator operator, mason tenders, pipe layers (installation of storm drainage or sewage lines on the street only), pneumatic drill operator, pneumatic gas and electric drill operator, power men and wagon drill operator, air track operator, block paver, curb setters, blasters, concrete spreaders.

- PAINTERS

Maintenance, preparation, cleaning, blasting (water and sand, etc.), painting or application of any protective coatings of every description on all bridges and appurtenances of highways, roadways, and railroads. Painting, decorating, hardwood finishing, paper hanging, sign writing, scenic art work and drywall hanging for any and all types of building and residential work.

- LEAD PAINT REMOVAL

- Painter's Rate

1. Removal of lead paint from bridges.
2. Removal of lead paint as preparation of any surface to be repainted.
3. Where removal is on a Demolition project prior to reconstruction.

- Laborer's Rate

1. Removal of lead paint from any surface NOT to be repainted.
2. Where removal is on a *TOTAL* Demolition project only.

- PLUMBERS AND PIPEFITTERS

Installation, repair, replacement, alteration or maintenance of all plumbing, heating, cooling and piping. **License required per Connecticut General Statutes: P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2 S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4.*

- POWER EQUIPMENT OPERATORS

Operates several types of power construction equipment such as compressors, pumps, hoists, derricks, cranes, shovels, tractors, scrapers or motor graders, etc. Repairs and maintains equipment. **License required, crane operators only, per Connecticut General Statutes.*

- ROOFERS

Covers roofs with composition shingles or sheets, wood shingles, slate or asphalt and gravel to waterproof roofs, including preparation of surface. (demolition or removal of any type of roofing and or clean-up of any and all areas where a roof is to be re-laid.)

- SHEETMETAL WORKERS

Fabricate, assembles, installs and repairs sheet metal products and equipment in such areas as ventilation, air-conditioning, warm air heating, restaurant equipment, architectural sheet metal work, sheet metal roofing, and aluminum gutters. Fabrication, handling, assembling, erecting, altering, repairing, etc. of coated metal material panels and composite metal material panels when used on building exteriors and interiors as soffits, fascia, louvers, partitions, canopies, cornice, column covers, awnings, beam covers, cladding, sun shades, lighting troughs, spires, ornamental roofing, metal ceilings, mansards, copings, ornamental and ventilation hoods, vertical and horizontal siding panels, trim, etc. The sheet metal classification also applies to the vast variety of coated metal material panels and composite metal material panels that have evolved over the years as an alternative to conventional ferrous and non-ferrous metals like steel, iron, tin, copper, brass, bronze, aluminum, etc. Fabrication, handling, assembling, erecting, altering, repairing, etc. of architectural metal roof, standing seam roof, composite metal roof, metal and composite bathroom/toilet partitions, aluminum gutters, metal and composite lockers and shelving, kitchen equipment, and walk-in coolers. To include testing and air –balancing ancillary to installation and construction.

- SPRINKLER FITTERS

Installation, alteration, maintenance and repair of fire protection sprinkler systems.

**License required per Connecticut General Statutes: F-1, 2, 3, 4.*

- TILE MARBLE AND TERRAZZO FINISHERS

Assists and tends the tile setter, marble mason and terrazzo worker in the performance of their duties.

- TRUCK DRIVERS

~How to pay truck drivers delivering asphalt is under REVISION~

Truck Drivers are required to be paid prevailing wage for time spent "working" directly on the site. These drivers remain covered by the prevailing wage for any time spent transporting between the actual construction location and facilities (such as fabrication, plants, mobile factories, batch plant, borrow pits, job headquarters, tool yards, etc.) dedicated exclusively, or nearly so, to performance of the contract or project, which are so located in proximity to the actual construction location that it is reasonable to include them. **License required, drivers only, per Connecticut General Statutes.*

For example:

- Material men and deliverymen are not covered under prevailing wage as long as they are not directly involved in the construction process. If, they unload the material, they would then be covered by prevailing wage for the classification they are performing work in: laborer, equipment operator, etc.
- Hauling material off site is not covered provided they are not dumping it at a location outlined above.
- Driving a truck on site and moving equipment or materials on site would be considered covered work, as this is part of the construction process.

➤ *Any questions regarding the proper classification should be directed to:*
Public Contract Compliance Unit
Wage and Workplace Standards Division
Connecticut Department of Labor
200 Folly Brook Blvd, Wethersfield, CT 06109
(860) 263-6543.

**Connecticut Department of Labor
Wage and Workplace Standards Division
FOOTNOTES**

- ⇒ Please Note: If the “Benefits” listed on the schedule for the following occupations includes a letter(s) (+ a or + a+b for instance), refer to the information below.

Benefits to be paid at the appropriate prevailing wage rate for the listed occupation.

If the “Benefits” section for the occupation lists only a dollar amount, disregard the information below.

Bricklayers, Cement Masons, Cement Finishers, Concrete Finishers, Stone Masons
(Building Construction) and
(Residential- Hartford, Middlesex, New Haven, New London and Tolland Counties)

- a. Paid Holiday: Employees shall receive 4 hours for Christmas Eve holiday provided the employee works the regularly scheduled day before and after the holiday. Employers may schedule work on Christmas Eve and employees shall receive pay for actual hours worked in addition to holiday pay.

Elevator Constructors: Mechanics

- a. Paid Holidays: New Year’s Day, Memorial Day, Independence Day, Labor Day, Veterans’ Day, Thanksgiving Day, Christmas Day, plus the Friday after Thanksgiving.
- b. Vacation: Employer contributes 8% of basic hourly rate for 5 years or more of service or 6% of basic hourly rate for 6 months to 5 years of service as vacation pay credit.

Glaziers

- a. Paid Holidays: Labor Day and Christmas Day.

Power Equipment Operators
(Heavy and Highway Construction & Building Construction)

- a. Paid Holidays: New Year’s Day, Good Friday, Memorial day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day, provided the employee works 3 days during the week in which the holiday falls, if scheduled, and if scheduled, the working day before and the working day after the holiday. Holidays falling on Saturday may be observed on Saturday, or if the employer so elects, on the preceding Friday.

Ironworkers

- a. Paid Holiday: Labor Day provided employee has been on the payroll for the 5 consecutive work days prior to Labor Day.

Laborers (Tunnel Construction)

- a. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. No employee shall be eligible for holiday pay when he fails, without cause, to work the regular work day preceding the holiday or the regular work day following the holiday.

Roofers

- a. Paid Holidays: July 4th, Labor Day, and Christmas Day provided the employee is employed 15 days prior to the holiday.

Sprinkler Fitters

- a. Paid Holidays: Memorial Day, July 4th, Labor Day, Thanksgiving Day and Christmas Day, provided the employee has been in the employment of a contractor 20 working days prior to any such paid holiday.

Truck Drivers

(Heavy and Highway Construction & Building Construction)

- a. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas day, and Good Friday, provided the employee has at least 31 calendar days of service and works the last scheduled day before and the first scheduled day after the holiday, unless excused.



THIS IS A PUBLIC WORKS PROJECT

Covered by the

PREVAILING WAGE LAW

CT General Statutes Section 31-53

If you have QUESTIONS regarding your wages
CALL (860) 263-6790

Section 31-55 of the CT State Statutes requires every contractor or subcontractor performing work for the state to post in a prominent place the prevailing wages as determined by the Labor Commissioner.

Sec. 31-53b. Construction safety and health course. New miner training program. Proof of completion required for mechanics, laborers and workers on public works projects. Enforcement. Regulations. Exceptions. (a) Each contract for a public works project entered into on or after July 1, 2009, by the state or any of its agents, or by any political subdivision of the state or any of its agents, described in subsection (g) of section 31-53, shall contain a provision requiring that each contractor furnish proof with the weekly certified payroll form for the first week each employee begins work on such project that any person performing the work of a mechanic, laborer or worker pursuant to the classifications of labor under section 31-53 on such public works project, pursuant to such contract, has completed a course of at least ten hours in duration in construction safety and health approved by the federal Occupational Safety and Health Administration or, has completed a new miner training program approved by the Federal Mine Safety and Health Administration in accordance with 30 CFR 48 or, in the case of telecommunications employees, has completed at least ten hours of training in accordance with 29 CFR 1910.268.

(b) Any person required to complete a course or program under subsection (a) of this section who has not completed the course or program shall be subject to removal from the worksite if the person does not provide documentation of having completed such course or program by the fifteenth day after the date the person is found to be in noncompliance. The Labor Commissioner or said commissioner's designee shall enforce this section.

(c) Not later than January 1, 2009, the Labor Commissioner shall adopt regulations, in accordance with the provisions of chapter 54, to implement the provisions of subsections (a) and (b) of this section. Such regulations shall require that the ten-hour construction safety and health courses required under subsection (a) of this section be conducted in accordance with federal Occupational Safety and Health Administration Training Institute standards, or in accordance with Federal Mine Safety and Health Administration Standards or in accordance with 29 CFR 1910.268, as appropriate. The Labor Commissioner shall accept as sufficient proof of compliance with the provisions of subsection (a) or (b) of this section a student course completion card issued by the federal Occupational Safety and Health Administration Training Institute, or such other proof of compliance said commissioner deems appropriate, dated no earlier than five years before the commencement date of such public works project.

(d) This section shall not apply to employees of public service companies, as defined in section 16-1, or drivers of commercial motor vehicles driving the vehicle on the public works project and delivering or picking up cargo from public works projects provided they perform no labor relating to the project other than the loading and unloading of their cargo.

(P.A. 06-175, S. 1; P.A. 08-83, S. 1.)

History: P.A. 08-83 amended Subsec. (a) by making provisions applicable to public works project contracts entered into on or after July 1, 2009, replacing provision re total cost of work with reference to Sec. 31-53(g), requiring proof in certified payroll form that new mechanic, laborer or worker has completed a 10-hour or more construction safety course and adding provision re new miner training program, amended Subsec. (b) by substituting "person" for "employee" and adding "or program", amended Subsec. (c) by adding "or in accordance with Federal Mine Safety and Health Administration Standards" and setting new deadline of January 1, 2009, deleted former Subsec. (d) re "public building", added new Subsec. (d) re exemptions for public service company employees and delivery drivers who perform no labor other than delivery and made conforming and technical changes, effective January 1, 2009.

Bid#23-126 Old Norwich Road Sewer Pump Station Upgrades

ATTACHMENT D

State of Connecticut Certificate of Compliance
with Connecticut General Statute Section 31-57b

STATE OF CONNECTICUT
Certificate of Compliance with
Connecticut General Statute Section 31 - 57b

I hereby certify that all of the statements herein contained below have been examined by me, and to the best of my knowledge and belief are true and correct.

The _____ **HAS / HAS NOT**
Company Name (Cross out Non-applicable)

been cited for three (3) or more willful or serious or serious violations of any Occupational Safety and Health Act (OSHA) or of any standard, order or regulation promulgated pursuant to such act, during the three year period preceding the bid, provided such violations were cited in accordance with the provisions of any State Occupational Safety and Health Act of 1970, and not abated within the time fixed by the citation and such citation has not been set aside following appeal to the appropriate agency of court having jurisdiction or **HAS / HAS NOT** (Cross out Non-applicable) received one or more criminal convictions related to the injury or death of any employee in the three-year period preceding the bid.

The list of violations (if applicable) is attached,

(Name of Firm, Organization or Corporation)

Signed:

Written Signature:

Name Typed: (Corporation Seal)

Title:

(Title of Above Person, typed)

Dated:

State of

County of

ss:

A.D., 20__

)

Sworn to and personally appeared before me for the above, _____,
(Name of Firm, Organization, Corporation)

Signer and Sealer of the foregoing instrument of and acknowledged the same to be the free act and deed of

(Name of Person appearing in front of Notary or Clerk)

(Title of Person appearing in front of Notary or Clerk)

My Commission Expires:

▼ and his/her free act and deed as

(Notary Public)

SECTION 00510

AGREEMENT

THIS AGREEMENT is by and between _____ (“Owner”) and
_____ (“Contractor”).

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

- 1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

The work involves, but is not limited to, the replacement of the raw sewage pumps and variable frequency drives, flow level and monitoring controls, motor control centers, pump station control panels, pump suction and discharge valves and piping, HVAC improvements and lighting.

ARTICLE 2 – THE PROJECT

- 2.01 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

Waterford Utility Commission – Bid #23-126

Old Norwich Road Sewer Pump Station Upgrades

ARTICLE 3 – ENGINEER

- 3.01 The Project has been designed by Wright-Pierce (Engineer), which is to act as Owner’s representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

- 4.01 *Time of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Days to Achieve Substantial Completion and Final Payment*

- A. The Work will be substantially completed within 335 days after the date when the Contract Times commence to run as provided in Paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions within 365 days after the date when the Contract Times commence to run.

4.03 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner \$1,000.00 for each day that expires after the time specified in Paragraph 4.02 above for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner \$1,000.00 for each day that expires after the time specified in Paragraph 4.02 above for completion and readiness for final payment until the Work is completed and ready for final payment.

ARTICLE 5 – CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the amounts determined pursuant to Paragraphs 5.01.A, 5.01.B, and 5.01.C below:

- A. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

- A. Contractor shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 30th day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below. All such payments will be measured by the schedule of values established as provided in Paragraph 2.07.A of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the General Conditions.

a. 95 percent of Work completed (with the balance being retainage).

b. 95 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 95 percent of the Work completed, less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions.

6.03 *Final Payment*

A. Upon final completion and acceptance of the Work in accordance with Paragraph 14.07 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 14.07. The Town of Waterford reserves the right to retain 5% of the final contract price for a period not to exceed six (6) months from the date of final acceptance of the project.

ARTICLE 7 – INTEREST

7.01 Not Used.

ARTICLE 8 – CONTRACTOR’S REPRESENTATIONS

8.01 In order to induce Owner to enter into this Agreement, Contractor makes the following representations:

A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.

B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities), if any, that have been identified in Paragraph SC-4.02 of the Supplementary Conditions as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions,

if any, at the Site that have been identified in Paragraph SC-4.06 of the Supplementary Conditions as containing reliable "technical data."

- E. Contractor has considered the information known to Contractor; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and (3) Contractor's safety precautions and programs.
- F. Based on the information and observations referred to in Paragraph 8.01.E above, Contractor does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.
- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

- A. The Contract Documents consist of the following:
 - 1. This Agreement (pages 1 to 7, inclusive).
 - 2. Performance bond
 - 3. Payment bond
 - 4. General Conditions (Section 00700, inclusive).
 - 5. Supplementary Conditions (Section 00800, inclusive).
 - a. Prevailing Wage Rates (all inclusive).
 - 6. Specifications as listed in the table of contents of the Project Manual.

7. Drawings consisting of 37 sheets with each sheet bearing the following general title: "Old Norwich Road Sewer Pump Station Upgrade".
 8. Addenda (numbers to, inclusive).
 9. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid (inclusive).
 - b. Documentation submitted by Contractor prior to Notice of Award.
 10. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:
 - a. Notice to Proceed
 - b. Work Change Directives.
 - c. Change Orders.
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 9.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 3.04 of the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 Terms

- A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.02 Assignment of Contract

- A. No assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 Successors and Assigns

- A. Owner and Contractor each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal

representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

- A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 - 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.06 *Other Provisions* - Not Applicable.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement. Counterparts have been delivered to Owner and Contractor. All portions of the Contract Documents have been signed or have been identified by Owner and Contractor or on their behalf.

This Agreement will be effective on _____ (which is the Effective Date of the Agreement).

OWNER:

By: _____

Title: _____

Attest: _____

Title: _____

Address for giving notices:

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

CONTRACTOR

By: _____

Title: _____

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____

Title: _____

Address for giving notices:

License No.: _____

(Where applicable)

Agent for service of process:

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly by



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Endorsed by



CONSTRUCTION SPECIFICATIONS INSTITUTE

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor (EJCDC C-520 or C-525, 2007 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the Narrative Guide to the EJCDC Construction Documents (EJCDC C-001, 2007 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (EJCDC C-800, 2007 Edition).

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
 5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 6. *Bidder*—The individual or entity who submits a Bid directly to Owner.
 7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).
 8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.
 9. *Change Order*—A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.
 10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.
 11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.
13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).
14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.
15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.
16. *Cost of the Work*—See Paragraph 11.01 for definition.
17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.
18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
19. *Engineer*—The individual or entity named as such in the Agreement.
20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.
21. *General Requirements*—Sections of Division 1 of the Specifications.
22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.
23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.
26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.
28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.
29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.
30. *PCBs*—Polychlorinated biphenyls.
31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.
32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.
34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.
35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.
37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.
39. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.
42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.
43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.
46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.
47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.
48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
49. *Unit Price Work*—Work to be paid for on the basis of unit prices.
50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.
51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an

addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

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

B. *Intent of Certain Terms or Adjectives:*

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

C. *Day:*

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

D. *Defective:*

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

E. *Furnish, Install, Perform, Provide:*

1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. When “furnish,” “install,” “perform,” or “provide” is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

- A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

- A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.07 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 - 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of

the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.
- C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

- A. Standards, Specifications, Codes, Laws, and Regulations
 1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Contractor's Review of Contract Documents Before Starting Work:* Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.
2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:
 - a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.
- B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:
 1. A Field Order;
 2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

- A. Contractor and any Subcontractor or Supplier shall not:
 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or
 2. reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

- A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.
- B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.
- C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

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

4.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the

Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

A. *Reports and Drawings:* The Supplementary Conditions identify:

- 1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and
- 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

- 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
- 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
- 3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:

- 1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or
- 2. is of such a nature as to require a change in the Contract Documents; or
- 3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

- B. *Engineer's Review:* After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:
 - a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or
 - b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 4.03.A.
3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and
2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all such information and data;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents;
 - c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and
 - d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 *Hazardous Environmental Condition at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 - 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.
- D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to

permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.

- E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.
- F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.
- G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.
- B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.
- C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

- A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

- A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.
- B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

- C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.
- D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.
- E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 *Contractor's Insurance*

- A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
 - 2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
 - 3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;
 - 4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:
 - a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or
 - b. by any other person for any other reason;
 - 5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
 - 6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.
- B. The policies of insurance required by this Paragraph 5.04 shall:
 - 1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners,

employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;
3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;
4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);
5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and
6. include completed operations coverage:
 - a. Such insurance shall remain in effect for two years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 *Property Insurance*

- A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of

them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.
 3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
 4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;
 5. allow for partial utilization of the Work by Owner;
 6. include testing and startup; and
 7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued.
- B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.
- C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.
- D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

- E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

- A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:
1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

- A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.
- B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

- A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

- A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 – CONTRACTOR’S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

6.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner’s written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.
- B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.
1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.
 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and “Or-Equals”*

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or “or-equal” item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.
1. *“Or-Equal” Items:* If in Engineer’s sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an “or-equal” item, in which case review and approval of the proposed item may, in Engineer’s sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and
 - 3) it has a proven record of performance and availability of responsive service.
 - b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. *Substitute Items:*

- a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.
- b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.
- c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.
- d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - 1) shall certify that the proposed substitute item will:
 - a) perform adequately the functions and achieve the results called for by the general design,
 - b) be similar in substance to that specified, and
 - c) be suited to the same use as that specified;
 - 2) will state:
 - a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,
 - b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;
 - 3) will identify:
 - a) all variations of the proposed substitute item from that specified, and
 - b) available engineering, sales, maintenance, repair, and replacement services; and
 - 4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

- B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.
- C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.
- D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- E. *Engineer's Cost Reimbursement:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- F. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.
- B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or

entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

- C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:
 - 1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor
 - 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.
- D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.
- E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.
- F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its

use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 *Permits*

- A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner

and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.11 *Use of Site and Other Areas*

A. Limitation on Use of Site and Other Areas:

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.
2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.
3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

- D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.
- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts

any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

- F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

- A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

- a. Submit number of copies specified in the General Requirements.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:*

- a. Submit number of Samples specified in the Specifications.

- b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.
- B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Submittal Procedures:*

- 1. Before submitting each Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
- 2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.
- 3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. *Engineer's Review:*

- 1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
- 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the

Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. Resubmittal Procedures:

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

6.18 *Continuing the Work*

- A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
4. use or occupancy of the Work or any part thereof by Owner;
5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;
6. any inspection, test, or approval by others; or
7. any correction of defective Work by Owner.

6.20 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.
- B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.
- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

- A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:
 - 1. written notice thereof will be given to Contractor prior to starting any such other work; and
 - 2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.
- B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe

access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

- C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:
 - 1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
 - 2. the specific matters to be covered by such authority and responsibility will be itemized; and
 - 3. the extent of such authority and responsibilities will be provided.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

- A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.
- B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.
- C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

ARTICLE 8 – OWNER’S RESPONSIBILITIES

8.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

- A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

- A. Owner’s duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner’s identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.06 *Insurance*

- A. Owner’s responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

- A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

- A. Owner’s responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner’s Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor’s means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws

and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

8.12 *Compliance with Safety Program*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed pursuant to Paragraph 6.13.D.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents.

9.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

- A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Authorized Variations in Work*

- A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

- A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

- A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.
- B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.
- C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.
- D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations

on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.
- B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.
- C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.
- D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of,

and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

- E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

9.10 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).
- B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

10.03 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:
 - 1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;
 - 2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
 - 3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of

executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

- A. *Engineer's Decision Required:* All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.
- B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).
- C. *Engineer's Action:* Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:
 - 1. deny the Claim in whole or in part;
 - 2. approve the Claim; or
 - 3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.
- D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

- E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.
- F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

- A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:
 - 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
 - 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 - 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.
 - g. The cost of utilities, fuel, and sanitary facilities at the Site.
 - h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.
 - i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.
 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.
- C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.
- D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances:*
1. Contractor agrees that:
 - a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in

the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. *Contingency Allowance:*

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 *Unit Price Work*

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:
 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
 2. there is no corresponding adjustment with respect to any other item of Work; and
 3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

- B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:
1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).
- C. *Contractor's Fee*: The Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or
 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

- A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.
- B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.
- D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.
- E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 *Notice of Defects*

- A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

13.03 *Tests and Inspections*

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:
 - 1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;
 - 2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and
 - 3. as otherwise specifically provided in the Contract Documents.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

- E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.
- F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

- A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.
- B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.
- C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.
- D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

- A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers,

architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

- B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. repair such defective land or areas; or
 - 2. correct such defective Work; or
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.
- C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

- A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 *Progress Payments*

A. *Applications for Payments:*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. *Review of Applications:*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's

review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

- a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
- a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
- a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

- a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
- b. the Contract Price has been reduced by Change Orders;
- c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
- d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due:

- 1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. Reduction in Payment:

- 1. Owner may refuse to make payment of the full amount recommended by Engineer because:
 - a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;
 - b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - c. there are other items entitling Owner to a set-off against the amount recommended; or
 - d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.
- 2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.
- 3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 Contractor's Warranty of Title

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.
- E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the tentative list.

14.05 *Partial Utilization*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.
2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *Final Payment*

A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;
 - b. consent of the surety, if any, to final payment;
 - c. a list of all Claims against Owner that Contractor believes are unsettled; and

- d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. Engineer's Review of Application and Acceptance:

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due:

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.08 Final Completion Delayed

- A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);
2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
3. Contractor's repeated disregard of the authority of Engineer; or
4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);

2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and
 3. complete the Work as Owner may deem expedient.
- C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.
- E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.
- F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
 3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other

dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or

2. agrees with the other party to submit the Claim to another dispute resolution process; or
3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 – MISCELLANEOUS

17.01 *Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
 1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or
 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

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

17.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION SC-32WAGE RATES

Wage rates apply to this project. The Wage Rates are attached to these specifications or will be supplied as a separate document, issued as an Addendum. It is the responsibility of the Contractor, before bid opening, to request, if necessary, any additional information on Wage Rates for those trades people who are not covered by the applicable Wage Rates, but who may be employed for the proposed work under this contract.

Additional wage classifications and rates can only be added after bid opening. If required classifications are not listed in the wage determination, the Contractor must list the classifications and the rates he proposes to pay. This list will be forwarded to the **Connecticut Department of Labor, Wage & Workplace Standards Division 200 Folly Brook Blvd., Wethersfield, CT 06109 / Department of Labor (DOL) in Washington, D.C.** for approval. If DOL rejects any or all of the proposed rates as being too low, the Contractor will be required to pay the higher rate at no increase in the total contract cost. In any event, the rates the Contractor proposes to pay to those unlisted classifications should not be lower than the rate paid to a laborer.

Preferred Employees: In the employment of mechanics, laborers or workmen to perform the work specified herein, preference shall be given to residents of the state who are, and continuously for at least six months prior to the date hereof have been, residents of this state, and if no such person is available then to residents of other states.

END OF SECTION

SECTION 00800SUPPLEMENTARY CONDITIONSSupplementary Conditions

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract Funding Agency Edition, EJCDC C-700 (2007 Edition), hereinafter called the General Conditions, and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof. The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

Contents of Supplementary Conditions

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SC-1 DEFINITIONS AND TERMINOLOGY

The terms used in these Supplementary Conditions which are defined in the General Conditions have the meanings assigned to them in the General Conditions.

SC-1.01.A.3. APPLICATION FOR PAYMENT

Add the following language to the end of Paragraph 1.01.A.3:

The Application for Payment form to be used on this Project is EJCDC No. C-620 or similar approved format.

SC-1.01.A.9. CHANGE ORDER

Add the following language to the end of Paragraph 1.01.A.9:

The Change Order form to be used on this Project is EJCDC No. C-941.

SC-1.01 A.29 OWNER

Add the following to the end of paragraph 1.29 of the General Conditions:

Owner is referred to as Grantee in certain sections of these Contract Documents. Owner and Grantee are one and the same.

SC-1.01 A.52 NON-RESIDENT CONTRACTOR

Add a new paragraph immediately after paragraph 1.01.A.51 of the General Conditions, which is to read as follows:

52. Non-Resident Contractor -

- a. A person who is not a resident in the State where the proposed construction is to be located, or
- b. Any partnership that has no member thereof resident in the State where the proposed construction is to be located.
- c. Any corporation established under laws other than those of the State in which the proposed construction is located.

SC-1.02.D DEFECTIVE

Insert the following language as paragraph 1.02 D.1.d:

- d. or fails to provide the level of service for which it was intended.

SC-2.01 DELIVERY OF BONDS AND EVIDENCE OF INSURANCE

Add a new paragraph immediately after paragraph 2.01.B of the General Conditions, which is to read as follows:

C. *Non-Resident Contractor:* The Contractor, if a corporation established under laws other than the State in which the proposed construction is located, shall file with the Owner, notice of the name of its resident attorney, appointed as required by the laws of the State in which the proposed construction is located. The Contractor, if a resident of a State other than that in which the proposed construction is located and not a corporation, shall file, at the time of execution of the Agreement, with the Owner a written appointment of a resident of the State in which the construction is located, having an office or place of business therein, to be his true and lawful attorney upon whom all lawful processes in any actions or proceedings against him may be served; and in such writing, which shall set forth said attorney's place of residence, shall agree that any lawful process against him which is served on said attorney shall be of the same legal force and validity as if served on him and that the authority shall continue in force so long as any liability remains outstanding against him in said State. The power of attorney shall be filed in the office of the Secretary of State if required, and copies certified by the Secretary shall be sufficient evidence thereof. Such appointment shall continue in force until revoked by an instrument in writing, designating in a like manner some other person upon whom such processes may be served, which instrument shall be filed in the manner provided herein for the original appointment.

SC-2.02 COPIES OF DOCUMENTS

Delete Paragraph 2.02.A in its entirety and insert the following in its place:

- A. Owner shall furnish to Contractor up to four printed or hard copies of the Drawings and Project Manual and one set in electronic pdf format. Additional copies will be furnished upon request at the cost of reproduction.

SC-2.03 COMMENCEMENT OF CONTRACT TIMES; NOTICE TO PROCEED

Delete Paragraph 2.03.A in its entirety and insert the following in its place:

- A. The Contract Times will commence to run on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement.

SC-3.01 INTENT

Add a new paragraph immediately after Paragraph 3.01 C of the General Conditions which is to read as follows:

- D. Each and every provision of law and clause required by law to be inserted in these Contract Documents shall be deemed to be inserted herein, and they shall be read and enforced as though it were included herein, and if through mistake or otherwise, any such provision is not inserted, or if not correctly inserted, then upon the application of either party, the Contract Documents shall forthwith be physically amended to make such insertion.

SC-4.02 SUBSURFACE AND PHYSICAL CONDITIONS

Delete Paragraphs 4.02.A and 4.02.B in their entirety and insert the following:

- A. No reports or explorations or tests of subsurface conditions at or contiguous to the Site, or drawings of physical conditions relating to existing surface or subsurface structures at the Site, are known to the Owner or Engineer.

SC-4.06 HAZARDOUS ENVIRONMENTAL CONDITION AT SITE

Delete Paragraphs 4.06.A and 4.06.B in their entirety and insert the following:

- A. No reports, explorations, tests or drawings of Hazardous Environmental Conditions at the Site are known to the Owner or Engineer.
B. Not used.

SC-5.04 CONTRACTOR'S INSURANCE

Add the following new paragraph immediately after Paragraph 5.04.B:

C. TOWN OF WATERFORD INSURANCE REQUIREMENTS ARE AS OUTLINED IN SECTION 00100.

SC-5.06 PROPERTY INSURANCE

Delete Paragraph 5.06.A in its entirety and insert the following in its place:

- A. Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof. Contractor shall be responsible for any deductible or self-insured retention. This insurance shall:
1. include the interests of Owner, Contractor, Subcontractors, Engineer, and and the officers, directors, partners, employees, agents and other consultants and subcontractors of any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or loss payee;

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework, and materials and equipment in transit and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by these Supplementary Conditions.
3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;
5. allow for partial utilization of the Work by Owner;
6. include testing and startup;
7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued; and
8. comply with the requirements of Paragraph 5.06.C of the General Conditions.

SC-6.02 LABOR; WORKING HOURS

Add the following sentence to the end of paragraph 6.02.B of the General Conditions.

"Regular working hours shall be 7:00AM to 5:00PM, Monday through Friday."

SC-6.06 CONCERNING SUBCONTRACTORS, SUPPLIERS, AND OTHERS

Add the following paragraph immediately after paragraph 6.06.C.2:

3. Owner or Engineer may furnish to any such Subcontractor, Supplier, or other individual or entity, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by a particular Subcontractor, Supplier, or other individual or entity.

Add a new paragraph immediately after Paragraph 6.06.G:

- H. The Contractor shall not award work valued at more than fifty (50%) percent of the Contract Price to Subcontractor(s), without prior written approval of the Owner.

SC-6.08 PERMITS

Add the following paragraph immediately after paragraph 6.08.A:

- B. The following permits/approvals have been or will be obtained by the Owner. Copies of the permits are or will be on file at the Owner's Offices. It is the responsibility of the Contractor to be familiar with the applicable provisions of each permit as they apply to the work. All other permits required by the Town shall be obtained and fees paid for by the Contractor.

1. NA

SC-6.10 TAXES

Add a new paragraph immediately after Paragraph 6.10.A:

- B. Owner is exempt from payment of sales and compensating use taxes of the State on all materials to be incorporated into the Work.
1. Owner will furnish the required certificates of tax exemption to Contractor for use in the purchase of supplies and materials to be incorporated into the Work.
 2. Owner's exemption does not apply to construction tools, machinery, equipment, or other property purchased by or leased by Contractor, or to supplies or materials not incorporated into the Work.

SC-6.19 CONTRACTOR'S GENERAL WARRANTY AND GUARANTEE

Add the following new paragraph 6.19.D., immediately after paragraph 6.19.B., of the General Conditions:

- D. CONTRACTOR shall guarantee all materials and equipment furnished and Work performed for a period of one (1) year from the date of Substantial Completion. CONTRACTOR warrants and guarantees for a period of one (1) year from the date of Substantial Completion of the systems that the completed systems are free from all defects due to faulty materials or workmanship and CONTRACTOR shall promptly make such corrections as may be necessary by reason of such defects including the repairs of any damage to other parts of the system resulting from such defects. OWNER will give notice of observed defects with reasonable promptness. In the event that CONTRACTOR should fail to make such repairs, adjustments, or other work that may be made necessary by such defects, OWNER may do so and charge CONTRACTOR the cost thereby incurred. The Performance Bond shall remain in full force and effect through the guarantee period."

SC-8.11 EVIDENCE OF FINANCIAL ARRANGEMENTS

SC-8.11 Add the following new paragraph immediately after paragraph 8.11.A:

B. On request of Contractor prior to the execution of any Change Order involving a significant increase in the Contract Price, Owner shall furnish to Contractor reasonable evidence that adequate financial arrangements have been made by Owner to enable Owner to fulfill the increased financial obligations to be undertaken by Owner as a result of such Change Order.

SC-9.03 PROJECT REPRESENTATION

Add a new paragraph immediately after paragraph 9.03A of the General Conditions which is to read as follows:

- B Resident Project Representative is Engineer's agent at the site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding Resident Project Representative's actions. Resident Project Representative's dealings in matters pertaining to the on-site work shall in general be with Engineer and Contractor keeping Owner advised as necessary. Resident Project Representative's dealings with subcontractors shall only be through or with the full knowledge and approval of Contractor. Resident Project Representative shall generally communicate with Owner with the knowledge of and under the direction of Engineer.
- 1 Duties and Responsibilities of Resident Project Representative:
 - 1.1 Schedules: Review the progress schedule, schedule of Shop Drawing submittals and schedule of values prepared by Contractor and consult with Engineer concerning acceptability.
 - 1.2 Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences and other project-related meetings, and prepare and circulate copies of minutes thereof.
 - 1.3 Liaison:
 - a. Serve as Engineer's liaison with Contractor, working principally through Contractor's superintendent and assist in understanding the intent of the Contract Documents; and assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-site operations.
 - b. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.
 - 1.4 Shop Drawings and Samples:
 - a. Record date of receipt of Shop Drawings and samples.
 - b. Receive samples which are furnished at the site by Contractor, and notify Engineer of availability of samples for examination.
 - c. Advise Engineer and Contractor of the commencement of any Work requiring a Shop Drawing or sample if the submittal has not been reviewed by Engineer.
 - 1.5 Review of Work, Rejection of Defective Work, Inspections and Tests:

- a. Conduct on-site observations of the Work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Report to Engineer whenever Resident Project Representative believes that any Work is unsatisfactory, faulty or defective or does not conform to the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of Work that Resident Project Representative believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
 - c. Verify that tests, equipment and systems startups and operating and maintenance training are conducted in the presence of appropriate personnel, and that Contractor maintains adequate records thereof; and observe, record and report to Engineer appropriate details relative to the test procedures and startups.
 - d. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the results of these inspections and report to Engineer.
- 1.6 Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.
- 1.7 Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report with recommendations to Engineer. Transmit to the Contractor decisions as issued by Engineer.
- 1.8 Records:
- a. Maintain at the job site orderly files for correspondence, reports of job conferences, Shop Drawings and samples, reproductions of original Contract Documents including all Work Directive Changes, Addenda, Change Orders, Field Orders, additional Drawings issued subsequent to the execution of the Contract, Engineer's clarifications and interpretations of the Contract Documents, progress reports, and other Project related documents.
 - b. keep a diary or log book recording Contractor hours on the job site, weather conditions, data relative to questions of Work Directive Changes, Change Orders or changed conditions, list of job site visitors, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.
 - c. Record names, address and telephone numbers of all contractors, subcontractors and major suppliers of materials and equipment.
- 1.9 Reports:
- a. Furnish Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the progress schedule and schedule of Shop Drawing and sample submittals.
 - b. Consult with Engineer in advance of scheduled major tests, inspections or start of important phases of the Work.
 - c. Draft proposed Change Orders and Work Directive Changes, obtaining backup material from Contractor and recommend to Engineer Change Orders, Work Directive Changes, and Field Orders.

- d. Report immediately to Engineer and Owner upon the occurrence of any accident.
- 1.10 Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the schedule of values, Work completed and materials and equipment delivered at the site but not incorporated in the Work.
- 1.11 Certificates, Maintenance and Operation Manuals: During the course of the Work, verify that certificates, maintenance and operation manuals and other data required to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have this material delivered to Engineer for review and forwarding to Owner prior to final payment for the Work.
- 1.12 Completion:
 - a. Before Engineer issues a Certificate of Substantial Completion, submit to Contractor a list of observed items requiring completion or correction.
 - b. Conduct final inspection in the company of Engineer, Owner and Contractor and prepare a final list of items to be completed or corrected.
 - c. Observe that all items on final list have been completed or corrected and make recommendations to Engineer concerning acceptance.
- 2 Limitations of Authority of the Resident Project Representative:
 - 2.1 Shall not authorize any deviation from the Contract Documents or substitution of materials or equipment, unless authorized by Engineer.
 - 2.2 Shall not exceed limitations of Engineer's authority as set forth in the Contract Documents.
 - 2.3 Shall not undertake any of the responsibilities of Contractor, subcontractors or Contractor's superintendent.
 - 2.4 Shall not advise on, issue directions relative to or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction unless such advice or directions are specifically required by the Contract Documents.
 - 2.5 Shall not advise on, issue directions regarding or assume control over safety precautions and programs in connection with the Work.
 - 2.6 Shall not accept Shop Drawing or sample submittals from anyone other than Contractor.
 - 2.7 Shall not authorize Owner to occupy the Project in whole or in part.
 - 2.8 Shall not participate in specialized field or laboratory tests or inspections conducted by others except as specifically authorized by Engineer.

SC-12.01 CHANGE OF CONTRACT PRICE

Delete the paragraph 12.01.C.2.c. in its entirety and replace with the following:

For all change order work performed, a fee for overhead and profit will be allowed over and above the "actual cost" of the work. For work performed by the contractor, this fee shall be

negotiable and not exceed fifteen percent (15%). For work performed by a subcontractor, this fee shall be negotiable and not exceed fifteen percent (15%) for the subcontractor and five (5%) percent for the general contractor. The general contractors five percent (5%) is calculated on the subcontractors actual cost before the fee is added.

SC-14.02 PROGRESS PAYMENTS

Add the following sentence at the end of paragraph 14.02.A.3:

No payments will be made that would deplete the retainage, place in escrow any funds that are required for retainage, or invest the retainage for the benefit of the Contractor.

SC-14.07 FINAL PAYMENT

Add a new paragraph immediately after paragraph 14.07.B.1 of the General Conditions which is to read as follows:

2. Two (2) percent of the total contract amount as reflected on the final Application for Payment shall be retained by Owner during the Correction Period. This retainage shall be held by Owner in an account without interest accruing to Contractor. All amounts otherwise due Contractor will be paid as described in paragraph 14.07.C of the General Conditions. At the end of the correction period, Owner shall pay Contractor the retainage less any amounts deducted for failure of Contractor to perform as outlined in Section 13 of the General Conditions.

SC-17 MISCELLANEOUS

Add the following new paragraphs immediately after paragraph 17.07. of the Supplementary Conditions:

17.08 Wage Rates:

- A. The requirements and provisions of all applicable laws and any amendments thereof or additions thereto as to the employment of labor, and to the schedule of minimum wage rates established in compliance with laws shall be a part of these Contract Documents. Copies of the wage schedules are included in SC-32 of these Supplementary Conditions. If, after the Notice of Award, it becomes necessary to employ any person in a trade or occupation not classified in the wage determinations, such person shall be paid at not less than such rates as shall be determined by the officials administering the laws mentioned above. Such approved minimum rate shall be retroactive to the time of the initial employment of such person in such trade or occupation. CONTRACTOR shall notify OWNER of CONTRACTOR's intention to employ persons in trades or occupations not classified in sufficient time for OWNER to obtain approved rates for such trades or occupations.
- B. The schedules of wages referred to above are minimum rates only, and OWNER will not consider any claims for additional compensation made by CONTRACTOR because of

payment by CONTRACTOR of any wage rate in excess of the applicable rate contained in these Contract Documents. All disputes in regard to the payment of wages in excess of these specified in the schedules shall be resolved by CONTRACTOR.

- C. The said schedules of wages shall continue to be the minimum rates to be paid during the life of this Agreement and a legible copy of said schedules shall be kept posted in a conspicuous place at the site of the work.
- D. The State schedule of minimum wage rates are included in SC-32 of these Supplementary Conditions. Where rates differ, the higher rates shall apply as a minimum for that trade.

SC-18 NOT USED

SC-19 NOT USED

END OF SECTION

SECTION SC-23

AMERICAN IRON AND STEEL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. In accordance with P.L. 113-76, Consolidated Appropriations Act, 2014, this project includes the requirement for American Iron and Steel (AIS). For the purposes of this project, iron and steel products shall be as defined herein.

1.2 DEFINITIONS

- A. Iron and Steel: For a product to be considered subject to the AIS requirements, it must be made of greater than 50% iron or steel, measured by cost. The cost should be based on the material costs.

Steel means an alloy that includes at least 50 percent iron, between 0.02% and 2% carbon, and may include other elements. Metallic elements such as chromium, nickel, molybdenum, manganese, and silicon may be added during the melting of steel for the purpose of enhancing properties such as corrosion resistance, hardness, or strength. This definition of steel includes carbon steel, alloy steel, stainless steel, tool steel and other specialty steels.

- B. Iron and Steel Products: refers to the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

Only the products listed herein made primarily of iron or steel, permanently incorporated into the project must be produced in the US. For example, trench boxes, scaffolding or equipment, which are removed from the project site upon completion of the project, are not required to be made of U.S. Iron or Steel.

Mechanical and electrical components, equipment and systems are not considered construction materials. Mechanical equipment is typically that which has motorized parts and/or is powered by a motor. Electrical equipment is typically any machine powered by electricity and includes components that are part of the electrical distribution system.

The following examples (including their appurtenances necessary for their intended use and operation) are NOT considered construction materials: pumps, motors, gear reducers, drives (including variable frequency drives (VFDs)), electric/pneumatic/manual accessories used to operate valves (such as electric valve actuators), mixers, gates, motorized screens (such as traveling screens), blowers/aeration equipment, compressors, meters, sensors, controls and switches, supervisory control and data acquisition (SCADA), membrane bioreactor systems,

membrane filtration systems, filters, clarifiers and clarifier mechanisms, rakes, grinders, disinfection systems, presses (including belt presses), conveyors, cranes, HVAC (excluding ductwork), water heaters, heat exchangers, generators, cabinetry and housings (such as electrical boxes/enclosures), lighting fixtures, electrical conduit, emergency life systems, metal office furniture, shelving, laboratory equipment, analytical instrumentation, and dewatering equipment.

- C. Production: Production in the United States of the iron or steel products used in the project requires that all manufacturing processes, including application of coatings, must take place in the United States, with the exception of metallurgical processes involving refinement of steel additives. All manufacturing processes includes processes such as melting, refining, forming, rolling, drawing, finishing, fabricating and coating.

Further, if a domestic iron and steel product is taken out of the US for any part of the manufacturing process, it becomes foreign source material. However, raw materials such as iron ore, limestone and iron and steel scrap are not covered by the AIS requirement, and the 7 material(s), if any, being applied as a coating are similarly not covered. Non-iron or steel components of an iron and steel product may come from non-US sources. For example, for products such as valves and hydrants, the individual non-iron and steel components do not have to be of domestic origin.

Raw materials, such as iron ore, limestone, scrap iron, and scrap steel, can come from non-US sources.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Iron and steel products shall include the following:
- Lined or unlined pipes or fittings;
 - Manhole Covers
 - Municipal Castings (defined in more detail below)
 - Hydrants
 - Tanks
 - Flanges
 - Pipe clamps and restraints
 - Valves
 - Structural steel (defined in more detail below)
 - Reinforced precast concrete
 - Construction materials (defined in more detail below)

2.2 MUNICIPAL CASTINGS

- A. Municipal castings are cast iron or steel infrastructure products that are melted and cast. They typically provide access, protection, or housing for components incorporated into utility owned drinking water, storm water, wastewater, and surface infrastructure. They are typically made of grey or ductile iron, or steel. Examples of municipal castings are:

Access Hatches
Ballast Screen
Benches (Iron or Steel)
Bollards
Cast Bases
Cast Iron Hinged Hatches, Square and Rectangular
Cast Iron Riser Rings
Catch Basin Inlet
Cleanout/Monument Boxes
Construction Covers and Frames
Curb and Corner Guards
Curb Openings
Detectable Warning Plates
Downspout Shoes (Boot, Inlet)
Drainage Grates, Frames and Curb Inlets
Inlets
Junction Boxes
Lampposts
Manhole Covers, Rings and Frames, Risers
Meter Boxes
Service Boxes
Steel Hinged Hatches, Square and Rectangular
Steel Riser Rings
Trash receptacles
Tree Grates
Tree Guards
Trench Grates
Valve Boxes, Covers and Risers

2.3 STRUCTURAL STEEL

- A. Structural steel is rolled flanged shapes, having at least one dimension of their cross-section three inches or greater, which are used in the construction of bridges, buildings, ships, railroad rolling stock, and for numerous other constructional purposes. Such shapes are designated as wide-flange shapes, standard I-beams, channels, angles, tees and zeos. Other shapes include H-piles, sheet piling, tie plates, cross ties, and those for other special purposes.

2.4 CONSTRUCTION MATERIALS

- A. Construction materials are those articles, materials, or supplies made primarily of iron and steel, that are permanently incorporated into the project, not including mechanical and/or electrical components, equipment and systems. Some of these products may overlap with what is also considered “structural steel”. This includes, but is not limited to, the following products: wire rod, bar, angles, concrete reinforcing bar, wire, wire cloth, wire rope and cables, tubing, framing, joists, trusses, fasteners (i.e., nuts and bolts), welding rods, decking, grating, railings, stairs, access ramps, fire escapes, ladders, wall panels, dome structures, roofing, ductwork, surface drains, cable hanging systems, manhole steps, fencing and fence tubing, guardrails, doors,

and stationary screens.

While reinforced precast concrete may not be at least 50% iron or steel, in this particular case, the reinforcing bar and wire must be produced in the US and meet the same standards as for any other iron or steel product. Additionally, the casting of the concrete product must take place in the US. The cement and other raw materials used in concrete production are not required to be of domestic origin. For reinforced concrete cast at the construction site, the reinforcing bar and wire are considered to be a construction material and must be produced in the US.

2.5 WAIVERS
A. None.

PART 3 - EXECUTION

3.1 CERTIFICATION

A. The Contractor, through its subcontractors, suppliers and manufacturers shall provide written certification to create a paper trail that documents the location of the manufacturing process involved with the production of iron and steel materials. Each handler (supplier, fabricator, manufacturer, processor, etc.) of the iron and steel products shall certify that their step in the process was domestically performed. Each time a step in the manufacturing process takes place, the manufacturer delivers its work along with a certification of its origin.

At a minimum, the certification shall include the name of the manufacturer, the location of the manufacturing facility where the product or process took place (not its headquarters), a description of the product or item being delivered, and a signature by a manufacturer's responsible party. Attached at the end of this section are sample certifications. These certifications should be submitted to the Owner through the Contractor.

3.2 INSTALLATION

A. All iron and steel products, as defined herein, shall be produced in the United States in accordance with the American Iron and Steel requirements of the Consolidated Appropriations Act 2014. If a potentially non-compliant product is installed in the permanent work, the will be required to remove the non-domestic item from the project.

EXAMPLE LETTER FOR AIS CERTIFICATION COMPLIANCE

Documentation must be provided on company letterhead.

Date
Company Name
Company Address
City, State Zip

Subject: American Iron and Steel Step Certification for Project (XXXXXXXXXX)

I, (company representative), certify that the (melting, bending, coating, galvanizing, cutting, etc.) process for (manufacturing or fabricating) the following products and/or materials shipped or provided for the subject project is in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

- 1.
- 2.
- 3.

Such process took place at the following location:

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

EXAMPLE LETTER FOR AIS CERTIFICATION COMPLIANCE

Documentation must be provided on company letterhead.

Date
Company Name
Company Address
City, State Zip

Subject: American Iron and Steel Certification for Project (XXXXXXXXXX)

I, (company representative), certify that the following products and/or materials shipped/provided to the subject project are in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

- 1.
- 2.
- 3.

Such process took place at the following location:

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

END OF SECTION

SECTION 01010A

SUMMARY OF WORK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Comprehensive Upgrades at the Old Norwich Road Sewer Pump Station in Town of Waterford, Connecticut. The major proposed work under this Contract includes:

Old Norwich Road Pump Station

1. Construction of:
 - a. New gas service installed by and with Eversource.
 - b. New dry-pit submersible pumps, washwater booster pump, bypass pumping connection, piping, valves and appurtenances;
 - c. New electrical gear and lighting;
 - d. New HVAC system;
 - e. Miscellaneous painting and other architectural improvements;
 - f. Piping, equipment systems, instrumentation, control and electrical systems, as indicated on the Drawings.
 - g. Other appurtenances as shown on the Drawings and specified herein.
 2. Demolition of:
 - a. Dry well and wet well contents including pumps, motors, piping, fittings, valves, gates, HVAC system, and associated electrical and instrumentation work;
 - b. Piping and conduit, as indicated on the Drawings.
 3. Maintain plant flow and treatment processes as detailed in Part 3 of this section and Specifications Section 01515.
 4. Remove and/or relocate equipment as indicated on the Drawings.
- B. Related Work Specified Elsewhere:
1. Coordination: Section 01050
 2. Construction Schedules: Section 01310.
 3. Temporary Bypass Pumping: Section 01515.
- C. Removals, Relocations and Rearrangements
1. Examine the existing site for the work of all trades which will influence the cost of the work under the bid. This work shall include removals, relocations and rearrangements which may interfere with, disturb or complicate the performance of the work under the bid involving systems, equipment and related service lines, which shall continue to be utilized as part of the finished project. The Contractor is responsible for all coordination in this regard.
 2. Provide in the bid a sufficient amount to include all removals, relocations, rearrangements and reconnections herein specified, necessary or required to provide approved operation and coordination of the combined new and existing systems and equipment.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 MAINTAIN EXISTING WORKS

A. Maintain Flows:

1. The Contractor shall be responsible for maintaining flows at all times during construction. All costs for maintaining flows shall be included in his lump sum bid prices. Pump Station daily flows to be maintained are identified in Section 01515.
2. The Contractor's operations shall not hinder the delivery, storage and use of materials and supplies, nor hinder staff duties, nor disrupt utility service.
3. The Owner must have access to the existing pump station and equipment at all times unless a specific exception is granted by the Owner.

B. Minimize Interference

1. The Contractor shall at all times conduct his operations so as to interfere as little as possible with existing works. The Contractor shall develop a program, in cooperation with the Owner, Engineer, and interested officials, which shall provide for the construction and putting into service of the new works in the most orderly manner possible. This program shall be adhered to except as deviations therefrom are expressly permitted.
2. Work of connecting with, cutting into, and reconstructing existing pipes or structures shall be planned to interfere with the operation of the existing facilities for the shortest possible time and when the demands on the facilities best permit such interference. It may be necessary to work outside of normal working hours to minimize interference. Before starting work which will interfere with the operation of existing facilities, the Contractor shall do all possible preparatory work and shall see that all tools, materials, and equipment are made ready and at hand.

3.2 CONSTRUCTION SEQUENCE

- A. Construction of the proposed pump station improvements will disrupt the existing pump station structures and operations to allow for the installation of the new pumps, piping, valves, electrical gear and wetwell isolation valves. To maintain flows and to minimize disruption, the construction must be divided into phases or sequenced appropriately. Suggested methods include utilizing temporary bypass pumping from sewer manholes upstream of the wetwell with temporary discharge piping tied temporarily (or permanently with the new bypass piping) into the existing force main when working within the existing wetwell and drywell. The method utilized shall provide for back up pumping and/or generator systems as necessary. Multiple bypassing event may be required depending on how the Contractor sequencing their work.
- B. The Contractor shall submit to the Engineer for review and acceptance a complete schedule of his proposed sequence of construction operations prior to commencing any work. This schedule shall include the Contractor's plans for doing the work.

- C. The Contractor must submit to the Engineer a written request to deviate from the above sequence, provided he can demonstrate to the Engineer that the continuity and degree of treatment will not be adversely affected.
- D. The Contractor shall include the cost of all temporary facilities required to maintain treatment during the construction period in his lump-sum bid price. The cost shall include the cost for all labor, tools, equipment and materials necessary.
- E. Pump Station daily flows to be maintained are identified in Section 01515.

END OF SECTION

SECTION 01045CUTTING, CORING AND PATCHINGPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included - This section establishes general requirements pertaining to cutting, excavating, coring, fitting, and patching of the Work required to:
 - 1. Make alterations to existing structures.
 - 2. Make the parts fit properly.
 - 3. Replace work not conforming to requirements of the Contract Documents.
 - 4. Contractor is responsible for all cutting, coring, and rough and finish patching. Contractor shall coordinate the work of any and all subcontracting trades performing the work.
 - 5. Contractor is responsible for reviewing with the Owner and Engineer and receiving permission to proceed prior to cutting and coring and patching.
- B. Related Work Specified Elsewhere:
 - 1. Pipe Sleeves and Seals are specified in Section 15092.
- C. Quality Assurance:
 - 1. Perform all cutting, coring and patching in strict accordance with pertinent requirements of these Specifications, and in the event no such requirements are determined, in conformance with the Engineer's written direction.
- D. Submittals: In accordance with the requirements specified in Section 01340. Provide the following information at least 30 days prior to cutting or coring:
 - a. Identification and qualifications of cutting/coring subcontractor(s) including: company name, business address contact information, or if by Contractor, indicated as such.
 - b. Key plan and schedule of cuts/cores indicating the: location of the cut/core, size (i.e., wall, floor, roof, etc.), equipment to be used and identification of any potential obstructions or embedded conduits and wiring.
- 2. Request for the Engineer's consent to proceed:
 - a. Prior to cutting which affects structural safety, submit written request to the Engineer for permission to proceed with cutting.
 - b. Should conditions of the work, or schedule, indicate a required change of materials or methods for cutting and patching, Contractor shall notify the Engineer and secure written permission prior to proceeding.

PART 2 - PRODUCTS2.1 MATERIALS

- A. Materials for replacement of work shall be equal to those of adjacent construction and shall comply with the pertinent sections of these Specifications.
- B. Concrete and grout for rough patching shall be as specified in Divisions 3 and 4.

PART 3 - EXECUTION

3.1 CONDITIONS

- A. Inspection:
 - 1. Inspect existing conditions, including elements subject to movement or damage during cutting, excavating, coring, backfilling, and patching.
 - 2. After uncovering the work, inspect conditions affecting installation of new work.
- B. Discrepancies:
 - 1. If uncovered conditions are not as anticipated, immediately notify the Engineer and secure needed directions.
 - 2. Do not proceed in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION PRIOR TO CUTTING AND CORING

- A. Provide all required protection including, but not necessarily limited to, shoring, bracing and support to maintain structural integrity of the work.
- B. All cutting and coring shall be performed in such a manner as to limit the extent of patching.
- C. All holes cut through concrete and masonry walls or slabs shall be core drilled unless otherwise approved. No structural members shall be cut without approval of the Engineer and all such cutting shall be done in a manner directed by Engineer. No holes may be drilled in beams or other structural members without obtaining prior approval. All work shall be performed by mechanics skilled in this type of work.
- D. If holes are cored through floor slabs they shall be drilled from below.
- E. The Contractor shall determine from Owner's information, logical deduction and field testing if there are embedded electrical conduits, wiring or piping in the coring locations and shall readjust locations if possible to avoid coring through them. If concealed embedded conduit and piping are damaged, or severed, the coring contractor shall immediately notify the Contractor, Owner and RPR to determine impact of the damage and develop and implement a plan to repair the damage and reactive the lines.
- F. If embedded concealed conduit, wiring or pipe is damaged or severed and all reasonable steps were taken by the Contractor to identify embedded items, and alternate routing was investigated, the repair work will be compensated by the Owner through a Change Order. If it was reasonable to expect an embedded item could have been present at the location, the Contractor shall repair at no additional cost to the Owner.

3.3 CORING

- A. Coring shall be performed with an approved non-impact rotary tool with diamond core drills. Size of holes shall be suitable for pipe, conduit, sleeves, equipment or mechanical seals to be installed.
- B. All equipment shall conform to OSHA standards and specifications pertaining to plugs, noise and fume pollution, wiring and maintenance.

- C. Provide protection for existing equipment, utilities and critical areas against water or other damage caused by drilling operation.
- D. Slurry or tailings resulting from coring operations shall be vacuumed or otherwise removed from the area following drilling. Slurry or tailings shall not be allowed to enter floor drains.
- E. Work area (e.g., adjacent walls, floors, ceilings, pipes, conduits, etc.) shall be cleaned to remove splash residues from coring operation.

3.4 CUTTING

- A. Cutting shall be performed with a concrete wall saw and diamond saw blades of proper size.
- B. Provide for control of slurry generated by sawing operation on both sides of wall.
- C. When cutting a reinforced concrete wall, the cutting shall be done so as not to damage bond between the concrete and reinforcing steel left in structure. Cut shall be made so that steel neither protrudes nor is recessed from face of the cut.
- D. Adequate bracing of area to be cut shall be installed prior to start of cutting. Check area during sawing operations for partial cracking and provide additional bracing as required to prevent a partial release of cut area during sawing operations.
- E. Provide equipment of adequate size to remove cut panel.
- F. Slurry or tailings resulting from cutting operations shall be vacuumed or otherwise removed from the area following drilling. Slurry or tailings shall not be allowed to enter floor drains.
- G. Work area (e.g., adjacent walls, floors, ceilings, pipes, conduits, etc.) shall be cleaned to remove splash residues from cutting operation.

3.5 PERFORMANCE

- A. Perform all required excavating and backfilling as required under pertinent sections of these specifications. Perform cutting, coring and demolition by methods which will prevent damage to other portions of the work and will provide proper surfaces to receive installation of repair and/or new work. Perform fitting and adjustment of products to provide finished installation complying with the specified tolerances and finishes.
- B. Coring or cutting which exposes cut surfaces of reinforcing steel or structural steel shall be coated. Coating shall be 10 mil (dry film thickness) applied in two 5 mil (dry film thickness) coats of a single component moisture cured coal tar urethane or two part coal tar epoxy corrosion barrier. Alternately the exposed steel can be cut back two inches from the surface and a non-shrink grout applied over the steel flush to the concrete core or cut surface.
- C. Rough patching shall be such as to bring the cut or cored area flush with existing construction unless otherwise shown.
- D. Finish patching shall match existing surfaces as approved.

END OF SECTION

SECTION 01050COORDINATIONPART 1 - GENERAL1.1 DESCRIPTION

- A. Contractor is required to work in close proximity to Owner's existing facilities. The Contractor, under this Contract, will be responsible for coordinating construction activities with Owner to ensure that services, facilities, and safe working conditions are maintained.
- B. Any damage to existing structures, equipment and property, accepted equipment or structures, and property or work in progress by others; as a result of the Contractor's or their subcontractor's operations shall be made good by the Contractor at no additional cost to the Owner.

1.2 COORDINATION WITH OTHERS

- A. Town of Waterford:
 - 1. Contractor shall coordinate access, egress, detours and traffic control, if required, at each site with the Waterford Police Department. The Contractor shall notify Waterford Police, Fire Department and Rescue Squad at least 24 hours in advance of any street closings or detours.
 - 2. Contractor shall coordinate all work on town property with Waterford Utility Commission (WUC) including activities that will interrupt wastewater flows.
- B. Eversource (Gas & Electricity):
 - 1. The Contractor shall be responsible for coordinating all work around Eversource facilities with Eversource and shall bear all costs of inspection requirements, temporary facilities relocation and other requirements. Eversource will also install the gas service at Old Norwich Road through the Contractor as an allowance item.
- C. Call Before You Dig (CBYD):
 - 1. The Contractor shall be responsible for coordinating and contacting CBYD prior to commencement of work.
- D. The Contractor shall provide the Engineer & Owner a construction schedule indicating the times to perform the work required. The Contractor shall update the schedule when required and give the facility one week notice before the start of any work. The Contractor shall provide the facility personnel enough time to obtain materials and perform the work required of them. The Contractor shall daily communicate with the Engineer & Owner concerning updating the schedule, job progress, delay or early starts that affect the treatment process, facility staffing, etc.

1.3 CONTRACTOR'S USE OF PREMISES

- A. Contractor work hours will be limited to 7:00AM to 7:00PM, Monday through Friday. Any work outside these hours will require permission of the Owner and adequate notice.
- B. Contractor shall coordinate delivery schedules, site access, and other construction-

related activities with any other contractors that may be hired by the Owner during the course of construction.

- C. Contractor shall assume full responsibility for security of all of their, and their subcontractors, materials and equipment stored on the site.
- D. If directed by the Owner, Contractor shall move any stored items which interfere with operations of Owner.
- E. Obtain and pay for use of additional storage or work areas if needed to perform the Work.
- F. Contractor shall not have access to Owners lunch room, toilet or locker room facilities at any time and shall provide all necessary facilities in accordance with Specification Section 01500.

END OF SECTION

SECTION 01150AMEASUREMENT AND PAYMENTPART 1 - GENERAL1.1 DESCRIPTION

- A. For lump sum items, payment shall be made to the Contractor in accordance with an accepted Progress Schedule and Schedule of Values on the basis of actual work completed.
- B. For unit-price items, payment shall be based on the actual amount of work accepted and for the actual amount of materials in place, as shown by the final measurements.
 - 1. All units of measurement shall be standard United States convention as applied to the specific items of work by tradition and as interpreted by the Engineer.
 - 2. At the end of each day's work, the Contractor's Superintendent or other authorized representative of the Contractor shall meet with the Resident Project Representative and determine the quantities of unit price work accomplished and/or completed during the work day.
 - 3. The Resident Project Representative will then prepare two "Daily Progress Reports" which shall be signed by both the Resident Project Representative and Contractor's Representative.
 - 4. Once each month the Resident Project Representative will prepare two "Monthly Progress Summation" forms from the month's accumulation of "Daily Progress Reports" which shall also be signed by both the Resident Project Representative and Contractor's Representative.
 - 5. These completed forms will provide the basis of the Engineer's monthly quantity estimate upon which payment will be made. Items not appearing on both the Daily Progress Reports and Monthly Progress Summation will not be included for payment. Items appearing on forms not properly signed by the Contractor will not be included for payment.
 - 6. After the work is completed and before final payment is made there for, the Engineer will make final measurements to determine the quantities of various items of work accepted as the basis for final settlement.

1.2 SCOPE OF PAYMENT

- A. Payments to the Contractor will be made for the actual quantities of the Contract items performed and accepted in accordance with the Contract Documents. Upon completion of the construction, if these actual quantities show either an increase or decrease from the quantities given in the Bid Form, the Contract unit prices will still prevail.
- B. The Contractor shall accept compensation, as herein provided, in full payment for furnishing all materials, labor, tools, equipment, and incidentals necessary to the completed work and for performing all work contemplated and embraced by the Contract; also for all loss or damage arising from the nature of the Work, or from the action of the elements, or from any unforeseen difficulties which may be encountered during the prosecution of the Work and until its final acceptance by the Engineer, and

for all risks of every description connected with the prosecution of the work, except as provided herein, also for all expenses incurred in consequence of the suspension of the work as herein authorized.

- C. The payment of any partial estimate or of any retained percentage except by and under the approved final invoice, in no way shall affect the obligation of the Contractor to repair or renew any defective parts of the construction or to be responsible for all damage due to such defects.

1.3 PAYMENT FOR INCREASED OR DECREASED QUANTITIES

- A. When alterations in the quantities of work not requiring supplemental agreements, as hereinbefore provided for, are ordered and performed, the Contractor shall accept payment in full at the Contract price for the actual quantities of work done. No allowance will be made for anticipated profits. Increased or decreased work involving supplemental agreements will be paid for as stipulated in such agreements.

1.4 OMITTED ITEMS

- A. Should any items contained in the bid form be found unnecessary for the proper completion of the work contracted, the Engineer may eliminate such items from the Contract, and such action shall in no way invalidate the Contract, and no allowance will be made for items so eliminated in making final payment to the Contractor.

1.5 PARTIAL PAYMENTS

- A. Partial payments shall be made monthly as the work progresses. Partial payment shall be made subject to the provisions of the Supplemental and General Conditions.
- B. Technical Specifications may include Special Payment Provisions which provide additional restrictions on partial payments.

1.6 PAYMENT FOR MATERIAL DELIVERED

- A. When requested by the Contractor and at the discretion of the Owner, payment may be made for all or part of the value of acceptable, non-perishable materials and equipment which are to be incorporated into bid items, have not been used, and have been delivered to the construction site or placed in storage places acceptable to the Owner. Payment shall be subject to the provisions of the General and Supplementary Conditions.
- B. No payment shall be made upon fuels, supplies, lumber, false work, or other materials, or on temporary structures or other work of any kind which are not a permanent part of the Contract.

1.7 FINAL PAYMENT

- A. The Engineer will make, as soon as practicable after the entire completion of the project, a final quantity invoice of the amount of the Work performed and the value of such Work. Owner shall make final payments of the sum found due less retainages subject to the provisions of the General and Supplementary Conditions.

1.8 INCIDENTAL WORK

- A. Incidental work items for which separate payment is not made include (but are not limited to) the following items:

1. Clearing, grubbing and stripping
2. Dust control
3. Temporary Construction Dewatering
4. Clean-up
5. Erosion control
6. Loam, seeding, grading, liming, fertilization, mulching and watering
7. Compaction testing of gravel or backfill
8. Restoration of property, and replacement of fences, curbs, structures, sign posts, guard rails, rock wall, mail boxes, traffic loop detectors and other minor items disturbed by the construction activities
9. Coordination with the Owner, Utilities and others, including related inspection cost (refer to Section 01050)
10. Utility crossings and relocations, unless payment is otherwise made
11. Traffic control plan and regulation
12. Project Signs
13. Routine flag person services
14. Trench boxes, steel and/or wood sheeting as required, including that left in place
15. Project record documents
16. Materials testing
17. Construction schedules, bonds, insurance, shop drawings, warranties, guarantees, certifications, and other submittals required by the Contract Documents
18. Repair and replacement of utilities damaged by construction activities and corresponding proper disposal of removed materials unless otherwise paid for
19. Cleaning, testing and disinfection of all water lines and appurtenances
20. Maintenance of all existing sewers flows and repair of existing sewer pipes
21. Final cleaning of sewers and force mains
22. Final testing of manholes and sewers
23. Removal and disposal of existing sewer structures and pipe as and where indicated in the Drawings
24. Temporary utilities for construction and to maintain existing service during construction
25. Temporary utility services to buildings as required to maintain service during construction
26. Quality assurance testing
27. Temporary construction and other facilities not to be permanently incorporated into the Work necessary for construction sequencing and maintenance of operations
28. Weather protection
29. Permits not otherwise paid for or provided by the Owner
30. Visits to the Project site or elsewhere by personnel or agents of the Contractor, including manufacturer's representatives, as may be required
31. On-site and other facilities acceptable to Engineer for the storage of materials, supplies and equipment to be incorporated into the Work
32. Facilities start-up services required by the Contract Documents

33. Mobilization/demobilization
34. Test pits to determine existing utility locations and elevations, soils conditions, groundwater conditions, dewatering requirements and as required to complete the project
35. Pipe markings
36. Pavement markings
37. Removal of existing pavement
38. Earthwork (except ledge)
39. Preconstruction photos and videos
40. Construction administration and insurance

1.9 DESCRIPTION OF PAY ITEMS

- A. The following sections describe the measurement of and payment for the work to be done under the respective items listed in the Bid Form.
- B. Each unit or lump sum price stated in the Bid Form shall constitute full compensation, as herein specified, for each item of the work completed.

(1) Old Norwich Road Pump Station Upgrade

Payment of the lump sum price for Item 1 shall be full compensation for furnishing all labor, materials, tools and equipment required and for upgrading of the pump station, complete as indicated on the Drawings and as specified and all its' appurtenances in its entirety, except that work included for payment under other items.

(2) Undocumented Site Conditions Allowance

- A. This general allowance is for compensating the Contractor for work resulting from encountered conflicts or additional work associated with undocumented site conditions, including, but not limited to, undocumented utilities, undocumented conflicts at interface of new and existing work, or for additional related work as determined by the Owner.
- B. This general allowance is not for correction of any errors or omissions made by the Contractor or for items that are specifically included in other Bid Items.
- C. The Contractor shall obtain written authorization from the Owner for payment from this general allowance.
- D. The Contractor shall be compensated for the work under this general allowance in accordance with the procedures specified in the General Conditions. At the end of the Contract, any and all remaining funds shall be deducted from the Contract via balancing change order.

(3) Utility Company Service Allowance

- A. Method of Measurement:
 1. Cash Allowance for electrical or gas utility work that may be required outside of the Base Bid work.
 2. Utility costs that may be applied to this allowance shall include only those costs for work that, per utility company requirements, prohibit the contractor from

performing the work. This could include electric utility work related to the existing electric utility transformer or new electric and gas utility meters. All work to be paid under this allowance must receive prior approval by Engineer.

3. All other utility costs (temporary power, bypass pumping, utilities for temporary facilities and general construction, etc.) shall be included in the Base Bid.

B. Basis of Payment:

1. Payment shall be made based receipt of actual invoices submitted by the utility company with any credits for this allowance shall be returned to the Owner under this contract.
2. The Contractor shall obtain written authorization from the Engineer or Owner prior to performing work on this bid item.
3. Adjustment to the final cost for this Item, if necessary, will be made based on the actual invoiced amounts. At the end of the Contract, any and all remaining funds shall be deducted from the Contract.

(4) Pump Station Remote Monitoring Programming Allowance

A. Method of Measurement:

1. Cash Allowance for programming that may be required for the Viper Radio telemetry unit (existing unit to be re-used as part of this project) and associated programming at the remote terminal location.

B. Basis of Payment:

1. Payment shall be made based on the Schedule of Values.
2. This allowance is not for programming of the programmable logic controller (PLC) and operator interface terminals (OIT). Programming for these items is included in the Lump Sum Bid Item 1.
3. Owner, at his discretion, may elect to perform this work in house.
4. The Contractor shall obtain written authorization from the Engineer or Owner prior to performing work on this bid item.
5. Adjustment to the final cost for this Item, if necessary, will be made based on the actual invoiced amounts. At the end of the Contract, any and all remaining funds shall be deducted from the Contract.

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: To enable orderly review during progress of the work, and to provide for systematic discussion of problems, the Engineer will conduct project meetings throughout the construction period.
- B. Related work described elsewhere: The Contractor's relations with their subcontractors and materials suppliers and discussions relative thereto, are the Contractor's responsibility and are not part of project meetings content.

1.2 QUALITY ASSURANCE

- A. Persons designated by the Contractor to attend and participate in the project meetings shall have all required authority to commit the Contractor to solutions agreed upon in the project meetings.

1.3 SUBMITTALS

- A. Agenda items: To the maximum extent practicable, advise the Engineer at least 24 hours in advance of project meetings regarding all items to be added to the agenda.
- B. Minutes: The Engineer will compile minutes of each project meeting and will furnish a copy to the Contractor. The Contractor may make and distribute such other copies as they wish.

PART 2 - PRODUCTS

(No products are required in this Section.)

PART 3 - EXECUTION

3.1 MEETING SCHEDULE

- A. Except as noted below for Preconstruction Meeting, project meetings will be held monthly. Coordinate as necessary to establish mutually acceptable schedule for meetings.

3.2 MEETING LOCATION

- A. Meetings will be held at the job site, unless the Owner and/or Engineer determines that virtual meetings are applicable and appropriate for any reason (e.g., COVID, Safety and Health Plan, etc.).
 - 1. If meetings are required by Owner/Engineer to be held virtually, Engineer will host the video-meetings via Microsoft Teams. All required meeting attendees are responsible for providing hardware necessary to view, share, be heard and hear content of the meeting.

3.3 PRECONSTRUCTION MEETING

- A. Preconstruction meeting will be scheduled within twenty days after the Effective Date of the Agreement, but before the Contractor starts work at the site. Provide attendance by authorized representatives of the Contractor and all major subcontractors. The Engineer will advise other interested parties and request their attendance.
- B. Minimum agenda: Distribute data on, and discuss:
 - 1. Identification of key project personnel for Owner, Engineer, Contractor, funding/regulatory Agencies.
 - 2. Responsibilities of Owner, Engineer, Resident Project Representative, Contractor.
 - 3. Channels and procedures for communications.
 - 4. Construction schedule, including sequence of critical work.
 - 5. Easements, permits.
 - 6. Contract Documents, including distribution of required copies of original documents and revisions.
 - 7. Processing of Shop Drawings and other data submitted to the Engineer for review.
 - 8. Processing of field decisions and Change Orders.
 - 9. Rules and regulations governing performance of the Work, including funding/regulatory Agency requirements.
 - 10. Procedures for safety and first aid, security, quality control, housekeeping, and other related matters.

3.4 PROJECT MEETINGS

- A. Attendance: To the maximum extent practicable, assign the same person or persons to represent the Contractor at project meetings throughout progress of the Work. The Superintendent shall attend. Subcontractors, materials suppliers, and others may be invited to attend those project meetings in which their aspects of the Work are involved.
- B. Minimum agenda:
 - 1. Review, revise as necessary, and approved minutes of previous meeting.
 - 2. Review progress of the Work since last meeting, including status of submittals for approval.
 - 3. Review schedule of work to be accomplished prior to next meeting.
 - 4. Discuss monthly partial payment request.
 - 5. Review status of change order requests and Work Directive Changes.
 - 6. Identify problems which impede planned progress.
 - 7. Develop corrective measures and procedures to regain planned schedule.
 - 8. Complete other current business.

END OF SECTION

SECTION 01310

CONSTRUCTION SCHEDULES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Within ten (10) days after the effective date of the Agreement between Owner and Contractor submit to the Engineer an estimated progress schedule as specified herein.
- B. Form of Schedules:
 - 1. Narrative: Completely describe the construction methods to be employed.
 - 2. Network Analysis System:
 - a. Provide a separate horizontal schedule line for each trade or operation and show concurrent and preceding activities.
 - b. Present in chronological order the beginning of each trade or operation showing duration and float time.
 - c. Scale: Identify key dates and allow space for updating and revision.
 - 3. Mathematical Analysis:
 - a. A mathematical analysis shall accompany the network diagram. A computer printout will be acceptable.
 - b. Information shall be included on activity numbers, duration, early start, late start, etc. and float times.
- C. Content of Schedules:
 - 1. Provide complete sequence of construction by activity:
 - a. Shop Drawings, Project Data and Samples:
 - i. Submittal dates.
 - ii. Dates reviewed copies will be required.
 - b. Decision dates for:
 - i. Products specified by allowances.
 - ii. Selection of finishes.
 - c. Estimated product procurement and delivery dates.
 - d. Dates for beginning and completion of each element of construction.
 - 2. Identify work of separate phases and logically grouped activities.
 - 3. Show the projected percentage of completion for each item of work as of the first day of each month.
 - 4. Provide separate sub-schedules, if requested by the Engineer, showing submittals, review times, procurement schedules, and delivery dates.
 - 5. Schedule sheets shall be printed in color on 24"x36" paper, unless a smaller size paper is allowed by the Engineer.
- D. Updating:
 - 1. Show all work activities including those already complete.
 - 2. Show all changes occurring since previous submission.
 - 3. Indicate progress of each activity, show completion dates.
 - 4. Include:
 - a. Major changes in scope.

- b. Activities modified since previous updating.
 - c. Revised projections due to changes.
 - d. Other identifiable changes.
5. Provide narrative report, including:
- a. Discussion of problem areas, including current and anticipated delay factors.
 - b. Corrective action taken or proposed.
 - c. Description of revisions that may affect schedules.
 - d. Description of activities to be performed in the next 6-week period.
 - e. Updated list of key shop drawings, project data and samples to be submitted in the next 6-week period.

1.2 SUBMITTALS

- A. Submit updated schedules with each progress payment request.
- B. Submit 4 copies of initial and updated schedules to the Engineer.

END OF SECTION

SECTION 01320

SAFETY AND HEALTH PLAN

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work, as outlined herein and in the General and Special Conditions of the Contract Documents. Within 10 days after the effective date of the Agreement between Owner and Contractor, submit to the Engineer a Safety and Health Plan as specified herein. Refer to submittals section below.
2. Contractor shall comply with all applicable Laws and Regulations related to the safety of persons or property, or for the protection of persons or property from damage, injury, illness, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.
3. Contractor shall designate a qualified and experienced safety representative (OSHA defined "Competent Person") at the site whose duties and responsibilities shall be the prevention of accidents and maintaining and supervising of safety precautions and programs, including a "Job Hazards Analysis".
4. The Contractor shall be solely responsible to provide all labor, equipment, and utilities sufficient to ensure no construction noise, particulates, or odors, are allowed to accumulate to levels which adversely affect health or work in, or near the construction area.

B. Content of Safety and Health Plan:

1. Prepare complete safety and health plan in accordance with the requirements of CFR Title 29 Part 1926 - Safety and Health Regulations for Construction.
 - a. Provide documentation that Contractor's hazardous communication program is up to date.
 - b. Provide documentation that Contractor's safety training is up to date.
 - c. Prepare a project specific Safety and Health Plan addressing construction safety and protection, including but not limited to excavations, fall protection and egress, as well as provisions for construction in hazardous environmental conditions at the pump station facility. The hazardous environmental conditions at the pump station include, but are not limited to, confined space entry, electrically-classified spaces, chemical storage and handling areas, biological hazards, to name a few.
2. Safety provisions for confined space entry shall follow the requirements of CFR Title 29 Part 1926, Subpart AA – Confined Spaces in Construction and will be incorporated into the Safety and Health Plan.
 - a. The Owner has provided Table 1 at the end of this section listing confined space locations which may be encountered during the execution of this Contract. The Contractor is required to perform a site evaluation to

- identify all hazards and potential hazards in work areas whether included in Table 1 or not, prior to control of site.
- b. The Contractor shall be responsible for all aspects of construction site safety including development of appropriate confined space entry procedures. The plan shall include, but not necessarily be limited to, the following:
 - i. Definitions
 - ii. Confined Space Evaluations
 - iii. Equipment Selection
 - iv. Confined Space Entry Training Documentation
 - v. Permit Required Confined Space Entry Requirements
 - vi. Testing (Monitoring) and Ventilation
 - vii. Confined Space Entry Permit Form
 - viii. Rescue and Emergency Procedures
 - ix. Emergency Contact Information
 - c. The Contractor shall inform the Owner and Engineer's representative whenever work will be performed in a confined space and the permit space program that the Contractor will follow.
 - d. The Contractor shall inform the Owner and Engineer's representative of any hazards confronted or created during entry operations, either through a briefing or during the entry operation.
 - e. The Contractor will coordinate entry operations with the Owner when both Owner personnel and Contractor personnel will be working in or near permit spaces.
 - f. The Owner, Engineer, their representatives, independent testing laboratories and government agencies, when inspecting the site, shall be supplied by the Contractor proper safety equipment when entry into a confined space is required.
3. The Owner has provided Table 2 at the end of this section listing the spaces that are considered "classified" per NFPA 820 (Standard for Fire Protection in Wastewater Treatment and Collection Facilities) where the Contractor may be required to carry out work tasks. The Contractor is required to perform a site evaluation to identify all hazards and potential hazards in work areas whether included in Table 2 or not, prior to control of site. Contractor shall implement appropriate safety precautions and/or construction practices to comply with classification requirements. Contractor shall ensure that all employees and subcontractors working in these areas have received appropriate training and are properly equipped in accordance with Contractor's Safety and Health Plan.
- C. Updating:
- 1. Contractor shall be responsible for updating the Safety and Health Plan as appropriate throughout the course of the construction period.

1.2 SUBMITTALS

- A. Submit the Contractor's site-specific Safety and Health Plan to the Engineer, in accordance with Section 01340. Submit hardcopy submittals, if required.
- B. Submit updated Safety and Health Plans as necessary during the course of the project.
- C. The Safety and Health Plan is provided "for information only" to inform the Owner,

Engineer and Resident Project Representative of the project specific safety program requirements; however, if the Safety and Health Plan incomplete (e.g., missing elements relevant to the project work), inadequate (e.g., outdated qualifications) or not project-specific, it will be returned “revise and resubmit”. Delays related to an incomplete Safety and Health Plan are the responsibility of the Contractor.

- D. The Contractor will overview the plan with the Owner (and staff), Engineer (and Resident Project Representative) prior to work beginning at the project site, and subsequently when/if the safety plan is updated.
- E. Contractor's most current Safety and Health Plan shall be available at the construction site throughout the construction project.

1.3 ON-SITE COORDINATION MEETINGS

- A. Contractor shall review key aspects of Safety and Health Plan at the Pre-Construction Meeting, and subsequent on-site safety informational meeting.
- B. Contractor shall report to Engineer and Owner at each progress meeting concerning compliance with the Safety and Health Plan for the most recent construction period and new considerations and requirements for the upcoming period.
- C. Contractor shall hold weekly on-site coordination meetings with Resident Project Representative and Owner to ensure that Owner's staff is aware of key Safety and Health Plan requirements of the current phase of construction.

1.4 OWNER’S CONFINED SPACE ENTRY PROGRAM INFORMATION

- A. A copy of the Owner’s Confined Space Entry Program is available for viewing at the facility and is not included herein.

1.5 SITE-SPECIFIC INFORMATION

- A. Refer to Tables 1, and 2 below for site specific information, excluding items such as manholes, handholes, etc.

TABLE 1
CONFINED SPACES LISTING

Confined Space Location	Hazard Description
Wetwell (Old Norwich Pump Station)	Possible lack of oxygen or presence of explosive or hazardous gases - Hydrogen Sulfide.

Note: This list has been provided by the Owner based upon their knowledge of the site and may not include all site hazards. Its intent is to aid the Contractor in determining the magnitude of effort needed to fulfill the safety and health requirements of this Contract.

TABLE 2
CLASSIFIED SPACES LISTING (NFPA 820)

Location	NFPA 820 Classification
Old Norwich Road Pump Station: • Lower Level – Wetwell. • Intermediate Level – Comminutor Room. • First Floor – Fan Room	Class 1, Division 1

Note: This list has been provided by the Owner based upon their knowledge of the site and may not include all site hazards. Its intent is to aid the Contractor in determining the magnitude of effort needed to fulfill the safety and health requirements of this Contract.

END OF SECTION

SECTION 01340SUBMITTALSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included:
 - 1. Submit all shop drawings, operations and maintenance manuals, Manufacturers' certificates, project data, and samples required by the Specifications.
- B. Related Work Specified Elsewhere:
 - 1. Construction Schedules: Section 01310
 - 2. Project Record Documents: Section 01720
 - 3. General Conditions: Section 00700.
- C. Submittals: This project shall utilize:
 - 1. Submittals – Electronic via Email/FTP with Hard Copy for Record
 - a. The Contractor shall submit to the Engineer an electronic submittal of shop drawings and O&M Manuals in portable document format (PDF) transmitted via email or file transfer protocol (FTP). The Engineer shall return an electronic PDF of the submittal review comments to the Contractor for distribution to subcontractors, suppliers and manufacturers. The electronic submittals shall serve as the electronic record of the project.
 - b. In addition, completed shop drawings and completed operations and maintenance (O&M) manuals shall be provided in hard copy (paper) format, for the record, in accordance with the following requirements.
 - i. Shop drawings and O&M manuals shall be considered “completed” once an action code of “0” or “1” has been attained, as specified below, unless otherwise directed by the Engineer.
 - ii. Once completed, the Contractor shall provide three hard copy sets (for Owner, Engineer and Resident Project Representative, respectively).
 - iii. Hard copy submittals shall be updated on a monthly basis, for those submittals completed during the preceding month.

1.2 SHOP DRAWINGS

- A. Shop Drawings are required for each and every element of the work.
- B. Shop Drawings are generally defined as all fabrication and erection drawings, diagrams, brochures, schedules, bills of material, manufacturers data, spare parts lists, and other data prepared by the Contractor, their subcontractors, suppliers, or manufacturers which illustrate the manufacturer, fabrication, construction, and installation of the work, or a portion thereof.
- C. The Contractor shall provide a completed Contractor Submittal Certification Form (copy provided for Contractor's use at the end of this Specification Section) which shall be attached to every copy of every shop drawing and signed by the Contractor and Manufacturer (where applicable). Shop Drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawing. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct for the work.

1. Each shop drawing submittal shall include a complete copy of the relevant specification section markup up to reflect “compliance” or “deviation” on an item-by-item basis.
- D. Shop Drawings shall be submitted as a complete package by specification section, unless otherwise reviewed and approved by the Engineer. It is the intent that all information, materials and samples associated with each specification section be included as a single submittal for the Engineer's review. Any deviation from this requirement, shall be requested in writing with an anticipated shop drawing breakdown/schedule prior to any associated submittal. An exception to this requirement are shop drawings for reinforcing steel, miscellaneous metals and structural steel, which shall be submitted separately for each structure unless otherwise permitted by the Engineer.
- E. The Contractor shall be responsible for the prompt and timely submittal of all shop and working drawings so that there shall be no delay to the work due to the absence of such drawings.
- F. No material or equipment shall be purchased or fabricated especially for the Contract until the required shop and working drawings have been submitted as hereinabove provided and reviewed for conformance to the Contract requirements. All such materials and equipment and the work involved in their installation or incorporation into the Work shall then be as shown in and represented by said drawings.
- G. Until the necessary review has been made, the Contractor shall not proceed with any portion of the work (such as the construction of foundations), the design or details of which are dependent upon the design or details of work, materials, equipment or other features for which review is required.
- H. All shop and working drawings shall be submitted to the Engineer by and/or through the Contractor, who shall be responsible for obtaining shop and working drawings from their subcontractors and returning reviewed drawings to them. Shop drawings shall be formatted to standard paper sizes to enable the Owner to maintain a permanent record of the submissions. Approved standard sizes shall be: (a) 24 inches by 36 inches; (b) 11 inches by 17 inches, and (c) 11 inches by 8-1/2 inches. Provision shall be made in preparing the shop drawings to provide a binding margin on the left hand side of the sheet. Shop drawings submitted other than as specified herein may be returned for resubmittal without being reviewed.
- I. Only drawings which have been checked and corrected by the fabricator should be submitted to the Contractor by their subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to confirm that the subject matter thereof conforms to the Drawings and Specifications in all respects. All drawings which are correct shall be marked with the date, checker's name, and indication of the Contractor's approval, and then shall be submitted to the Engineer.
- J. If a shop drawing shows any deviation from the Contract requirements, the Contractor shall make specific mention of the deviations in the transmittal. Shop Drawings that contain significant deviations that are not brought to the attention of the Engineer may be subject to rejection.
- K. Should the Contractor submit equipment that requires modifications to the structures, piping, electrical conduit, wires and appurtenances, layout, etc., detailed on the Drawings, Contractor shall also submit details of the proposed modifications. If such

equipment and modifications are accepted, the Contractor, at no additional cost to the Owner, shall do all work necessary to make such modifications.

- L. A maximum of two submissions of each Shop Drawing will be reviewed, checked, and commented upon without charge to the Contractor. Any additional submissions which are ordered by the Engineer to fulfill the stipulations of the Drawings and Specifications, and which are required by virtue of the Contractor's neglect or failure to comply with the requirements of the Drawings and Specifications, or to make those modifications and/or corrections ordered by the Engineer in the review of the first two submissions of each Shop Drawing, will be reviewed and checked as deemed necessary by the Engineer, and the cost of such review and checking, as determined by the Owner, and based upon Engineer's documentation of time and rates established for additional services in the Owner-Engineer Agreement for this Project, may be deducted from the Contractor to make all modifications and/or corrections as may be required by the Engineer in an accurate, complete, and timely fashion. Resubmittals for the sole purpose of providing written responses to review comments will not be considered a resubmittal counting towards the two submission limit.
- M. Shop Drawings that include drawings or other material that is illegible or too small may be returned without review.

1.3 SAMPLES

- A. The Contractor shall submit samples when requested by the Engineer to establish conformance with the specifications, and as necessary to define color selections available. Submittals of "samples" shall be documented through the electronic submittal process by including a photograph of the item(s) and indicating the date the sample was mailed and/or delivered.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. Operation and Maintenance (O&M) Manuals are required for certain elements of the project, as specified herein.
- B. The Contractor shall provide a completed Operation and Maintenance Manual Certification Form (copy provided for Contractor's use at the end of this Specification Section) which shall be attached to every copy of every Manual and signed by the Contractor and Manufacturer.
- C. Each hard copy of an O&M Manual shall be provided in a stand-alone binder or shall be suitable for insertion into a 3-ring binder. Include the General Contractor's and Manufacturer's representative's contact information on the front cover. O&M manuals must be appropriate for the project and customized for the project. If a Manufacturer's standard O&M manual is included in the submittal, all non-applicable content must be removed or crossed out.
- D. O&M Manuals shall contain the following operational information:
 - 1. Safety Precautions: List personnel hazards, equipment or product safety precautions for all operating conditions.
 - 2. Operator Prestart: Include all procedures required to set up and prepare each system, equipment or component for use.
 - 3. Startup Procedures: Provide a narrative description for all startup operating procedures, include all control sequences.
 - 4. Shutdown Procedures: Provide a narrative description for all shutdown operating procedures, include all control sequences.

5. Post-Shutdown Procedures: Provide a narrative description for all post-shutdown operating procedures, include all control sequences.
 6. Normal Operating Procedures: Provide a narrative description of normal operating procedures. Include control diagrams with data to explain operation and control of systems and specific equipment.
 7. Emergency Operations: Include emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.
 8. Operator Service Requirements: Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, alignment, spare parts installation and gage reading or recording.
 9. Environmental Conditions: Include a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which the equipment should not be allowed to run.
- E. O&M Manuals shall contain the following maintenance information:
1. Lubrication Data: Include a table showing recommended lubricants for specific temperature ranges and applications. Also, include charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, capacities and a lubrication schedule showing service interval frequency
 2. Preventative Maintenance Plan: Include the manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation as well as to ensure minimization of corrective maintenance and repair. Provide the manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide the manufacturer's specified frequency and procedures for each separate operation.
 3. Troubleshooting Guides: Include recommendations on procedures and instructions for correcting problems and making repairs. Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.
 4. Wiring and Control Diagrams: Provide Wiring diagrams and control diagrams. All diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to the actual installation numbering.
 5. Maintenance and Repair Procedures: Include instructions and list the tools required to restore products and/or equipment to proper conditions or operating standards.

6. Removal and Replacement Instructions: Include step-by-step procedures, list required tools/supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.
 7. Spare Parts and Supply Lists: Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration shall be required for facilities at remote locations. List spare parts and supplies that have a long lead times to obtain.
 8. Corrective Maintenance Work Hours: Include the manufacturer's projection of corrective maintenance work-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.
- F. O&M Manuals shall contain the following additional information:
1. Parts Identification: Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirements to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items.
 - a. When illustrations omit a part number and description, both the illustration and a separate listing shall show the index, reference, or key number which shall cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as a master parts catalog, in accordance with the manufacturer's standard commercial practice.
 2. Warranty Information: List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force. Include warranty information for all primary components included in product systems.
 3. Personnel Training Requirements: Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.
 4. Testing and Special Tools: Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.
 5. Contractor Information: Provide a list that includes the name, address, and telephone number of the General Contractor and each subcontractor installing the respective product or equipment. Include local representatives and service organizations most convenient to the project site. Provide the name, address, and telephone number of the product or equipment manufacturers.

1.5 MANUFACTURER'S CERTIFICATES

- A. Prior to accepting the installation, the Contractor shall submit manufacturer's certificates for each item specified.
- B. Such manufacturer's certificates shall state that the equipment has been installed under either the continuous or periodic supervision of the manufacturer's authorized representative, that it has been adjusted and initially operated in the presence of the manufacturer's authorized representative, and that it is operating in accordance with the specified requirements, to the manufacturer's satisfaction. All costs for meeting this requirement shall be included in the Contractor's bid price.

1.6 SUBMISSION REQUIREMENTS

- A. Accompany submittals with a transmittal cover sheet, containing:
 - 1. Date.
 - 2. Project title and number.
 - 3. Contractor's name and address.
 - 4. The sequential shop drawing number for each shop drawing, project data and sample submitted shall be:
 - a. Specification Section number followed by a dash and then a sequential number beginning with 01 (e.g., 16000-01).
 - b. Under limited situations when additional different pieces of equipment are submitted under the same specification section, those submittals shall be numbered sequentially (e.g. 05500-01, 05500-02, 05500-03, etc.).
 - c. Resubmittals shall include an alphabetic suffix after the corresponding sequential number (e.g., 16000-01A).
 - d. O&M submittals shall be numbered with the Specification Section number followed by a dash, the letters "OM", another dash, and then a sequential number beginning with 01 (e.g. 16000-OM-01). Resubmittals of O&Ms shall include an alphabetic suffix after the corresponding sequential number (e.g. 16000-OM-01A).
 - 5. Notification of deviations from Contract Documents.
 - 6. Other pertinent data.
- B. A completed Contractor Submittal Certification Form shall be attached to each hardcopy and electronic PDF of each shop drawing and must include:
 - 1. Project name
 - 2. Specification Section and sequential number with alphabet suffix for resubmittal
 - 3. Description
 - 4. Identification of deviations from Contract Documents.
 - 5. Contractor's stamp, initialed or signed, certifying review of the submittal, verification of field measurements and compliance with Contract Documents.
 - 6. Where specified or when requested by the Engineer, manufacturer's certification that equipment, accessories and shop painting meet or exceed the Specification requirements.
 - 7. Where specified, manufacturer's guarantee.

C. Additional Requirements for Electronic Submittals:

1. Each individual shop drawing or O&M submittal shall be contained in one PDF.
2. The first page of the PDF shall be the Contractor Submittal Certification Form as described above.
3. The electronic PDF shall be **exactly** as submitted in the hardcopy.
4. The electronic PDF shall include an electronic table of contents that is bookmarked for each section of the submittal.
5. The electronic PDF shall be configured such that is fully searchable.
6. PDF versions of 24x36 drawings shall be converted to 24 x 36 PDFs so as not to lose the clarity of the original drawing.
7. Electronic PDF submittals that are not submitted in accordance with the requirements stated above will not be reviewed by the Engineer.
8. Electronic submittals shall be transmitted via the protocol established in Part 1 above.

1.7 RESUBMISSION REQUIREMENTS

- A. Revise initial submittals as required and resubmit as specified for initial submittal.
- B. Indicate on submittals any changes which have been made other than those required by Engineer. All renumbering of shop drawings, relabeling of individual pieces or assemblies or relocating of pieces or assemblies to other Drawings within the submittal shall be clearly brought to the attention of the Engineer. If relabeling of individual pieces or assemblies has taken place, the labels from the previous submittal shall be indicated to assist in comparing the original and resubmitted shop drawing.
- C. All resubmittals shall include a summary of the previous submittal review comments with the vendors' written response as to how the previous comments were addressed.

1.8 ENGINEER'S REVIEW

- A. The review of shop and working drawings hereunder will be general only, and nothing contained in this specification shall relieve, diminish or alter in any respect the responsibilities of the Contractor under the Contract Documents and in particular, the specific responsibility of the Contractor for details of design and dimensions necessary for proper fitting and construction of the work as required by the Contract and for achieving the result and performance specified thereunder.
- B. The Engineer's review comments will be summarized on a Submittal Review Form, which includes an action code. A description of each action code is provided below.
 1. No Exceptions Taken (Status 0 on shop drawing log). The shop drawing complies with the Contract Document requirements. No changes or further information are required. Where appropriate, the submittal review form will be used to alert the Contractor, Owner and Field personnel of remaining items within that specification section that still needs to be submitted.
 2. Make Corrections Indicated (Status 1 on shop drawing log). The shop drawing complies with the Contract Document requirements except for minor changes, as indicated. Engineer requires that all comments will be addressed by the Contractor, unless otherwise notified in writing prior to execution of the relevant work.
 3. Conditional to Remarks (Status 2 on shop drawing log). The shop drawing potentially complies with the Contract Document requirements, contingent upon satisfactory resolution of review comments. Remarks will explicitly list

what information needs to be resubmitted. Resubmittal from the Contractor should include a cover letter or summary which indicates how each review comment has been addressed. **This action code will not be used, or will be sparingly used, for electronic submittals.**

4. Revise and Resubmit (Status 3 on shop drawing log). The shop drawing does not comply with the Contract Document requirement as submitted, but may with changes indicated and/or submission of additional information. The entire package must be resubmitted with the necessary information and a cover letter which indicates how each review comment has been addressed and where to find the information in the resubmittal.
5. Rejected (Status 4 on shop drawing log). The shop drawing does not comply with the Contract Document requirements, for the reasons indicated in the remarks, and is unacceptable.
6. For Information Only (Status 5 on shop drawing log). The shop drawing review was for information only.
7. In Review (Status 6 on shop drawing log). The shop drawing is currently under review.

CONTRACTOR SUBMITTAL CERTIFICATION FORM

PROJECT: _____ CONTRACTOR'S PROJ. NO: _____

CONTRACTOR: _____ ENGINEER'S PROJ. NO: _____

ENGINEER: _____

SHOP
DRAWING
NUMBER:SPECIFICATION SECTION
OR DRAWING NO:SEQUENTIAL NUMBER
(& ALPHA SUFFIX FOR
RESUBMITTAL)

DESCRIPTION: _____

MANUFACTURER: _____

The above referenced submittal has been reviewed by the undersigned and I/we certify that the material and/or equipment meets or exceeds the project specification requirements with

☐ NO DEVIATIONS

or

☐ A COMPLETE LIST OF DEVIATIONS AS FOLLOWS^a:

By: _____ By: _____

Contractor^bManufacturer^c

Date: _____ Date: _____

a Any deviations not brought to the attention of the Engineer for review and concurrence shall be the responsibility of the Contractor to correct, if so directed.

b Required on all submittals

c When required by specifications Page ____ of ____

General Contractor's Stamp

OPERATIONS AND MAINTENANCE MANUAL CERTIFICATION FORM

PROJECT: _____ CONTRACTOR'S PROJ. NO: _____

CONTRACTOR: _____ ENGINEER'S PROJ. NO: _____

ENGINEER: _____

O&M NUMBER:	_____	- OM -	_____
	SPECIFICATION SECTION OR DRAWING NO:		SEQUENTIAL NUMBER (& ALPHA SUFFIX FOR RESUBMITTAL)

DESCRIPTION: _____

MANUFACTURER: _____

The above referenced operations and maintenance manual has been reviewed by the undersigned and I/we certify that the manual is customized as needed for this project, is suitable for mounting in a 3-ring binder, and contains the following items:

- | | |
|--|--|
| ☐ Table of Contents | ☐ Project-Related Design Data |
| ☐ Contractor and Manufacturer Contact Information | ☐ Serial Numbers |
| ☐ Preventative Maintenance Schedule and Summary | ☐ Maintenance and Repair Procedures |
| ☐ Removal and Replacement Instructions | ☐ Wiring and Control Diagrams |
| ☐ Lubrication Schedule | ☐ Equipment Drawings & Schematics |
| ☐ Troubleshooting Information | ☐ Equipment Performance Curves |
| ☐ Warranty Information | ☐ Parts and Service Contact Information |
| ☐ Rebuild Information for All Components | ☐ Manufacturer's Contact Information |
| ☐ Startup, Operation and Shutdown Procedures | ☐ Emergency Operations Plan |
| ☐ Normal and Emergency Operations | ☐ List of All Component Part Numbers |
| ☐ Safety Procedures and Precautions | ☐ List of Spare Parts Supplied |
| ☐ Shop Drawings corrected to As-Built Conditions | ☐ Testing Equipment & Special Tools |
| ☐ Personnel Training Requirements | ☐ Other System Specific Information |

By: _____ By: _____

Contractor^a

Manufacturer^b

Date: _____ Date: _____

^a Contact information shall include name, address and telephone number.

^b Required on all Operation and Maintenance Manuals.

^c When required by Specifications. Page ____ of ____

General Contractor's Stamp

PROCESS EQUIPMENT MANUFACTURER SUBMITTAL CERTIFICATION
(Divisions 11)

Owner: _____ Date: _____

Project: _____

Contractor: _____

Equipment Manufacturer: _____

Equipment: _____

As an authorized representative of the equipment manufacturer, the undersigned certifies that the equipment listed above conforms to the requirements of Section 11000, Part 1.3.K. The undersigned authorized representative of the manufacturer further certifies that the equipment manufacturer or supplier has: reviewed the Construction Documents, the intended installation by the Contractor, and the intended functional and operational conditions; determined all conditions to be acceptable; and found no conditions which would cause the warranty to be void; or the equipment to function improperly, or not meet the performance requirements.

(Authorized Representative of the Manufacturer)

(Date)

END OF SECTION

SECTION 01370

SCHEDULE OF VALUESPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. Provide a detailed breakdown of the Contract Sum showing values allocated to each of the various parts of the Work, as specified herein and in other provisions of the Contract Documents.

B. Related Work Specified Elsewhere:

1. Section 00700 – General Conditions
2. Section 00800 – Supplemental Conditions
3. Section 00844 – Contractor's Application for Payment
4. Section 01340 – Submittals

1.2 QUALITY ASSURANCE

A. Use required means to assure arithmetical accuracy of the sums described.

- B. When so required by the Engineer, provide copies of the subcontracts or other data acceptable to the Engineer substantiating the sums described.

1.3 SUBMITTALS

- A. The proposed schedule of values (hereinafter referred to as "SOV"), meeting the requirements outlined below, shall be submitted to the Engineer for review. The SOV shall be used as the basis for reviewing and approving payment requisitions along with determining percentages of work completed. No payment requisitions will be processed until the Engineer has taken no exceptions to the schedule of values.

- B. The SOV shall consist of a detailed breakdown of all the work within the Contract Documents, as specified herein, and shall include a sufficient number of work items to serve as an accurate basis the General Contractor's Application for Payment. Each work item shall include its prorated share of overhead and profit and subcontractor markup. The breakdown shall provide the level of detail outlined below.

1. General Conditions:

- a. Includes all work indicated in all specifications within Division 0 and 1.

2. Civil and Site Work:

- a. Includes all work indicated on the Civil (C) Drawings and all specifications within Division 2.

3. Architectural:

- a. Breakdown by building and structures.
 - b. Includes all work indicated on the Architectural (A) Drawings and in all specifications.

4. Structural:

- a. Breakdown by building and structures.

- b. Includes all work indicated on the Structural (S) Drawings and in all specifications within Divisions 3, 5 and 13 (through and including Section 13133).
- 5. Process Equipment:
 - a. Breakdown by process system, including submittals, O&M manuals, equipment, installation, startup, commissioning and training.
 - b. Includes all work indicated on the Process (PR) Drawings and in all specifications within Division 11 and relevant specifications in Divisions 15.
- 6. Mechanical and Plumbing:
 - a. Breakdown by building and structures.
 - b. Includes all work indicated on the Mechanical (M) Drawings and in relevant specifications within Division 15.
- 7. Instrumentation and System Integration:
 - a. Breakdown by overall network, overall instruments, overall programming, startup, commissioning, and training.
 - b. Includes all work indicated on the Instrumentation (I) Drawings and in all specifications within Division 13.
- 8. Electrical:
 - a. Breakdown by overall utility service, power distribution, standby power, building and structures, startup and commissioning.
 - b. Breakdown ductbank costs on a linear foot basis.
 - c. Breakdown conduit and wire separately.
 - d. Includes all work indicated on the Electrical (E) Drawings and in all specifications within Division 16.
- 9. Line items shall be broken down into work performed by the General Contractor or a Subcontractor
- 10. Provide an aggregate percentage completed calculation for each major subcontractor (e.g., site, HVAC, ATC, systems integrator, plumber, electrician, etc.).
- 11. If a work item, or series of work items, are separated into construction phases which will require phased payments, the SOV shall have separate line item values for each phase.

END OF SECTION

SECTION 01380CONSTRUCTION PHOTOGRAPHSPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. Pre-Construction Record: Contractor shall take digital photographs and video to obtain a visual record of the project area prior to beginning any work at the project site.
2. Construction Record: Contractor shall utilize digital photographs to obtain a visual record of the project area at monthly intervals during the project.
3. Post-Construction Record: Contractor shall utilize digital photographs of the project site after the work has been completed.
4. Notify Engineer at least three (3) working days prior to photographing or videoing the project area so Engineer may, at their option, observe.

1.2 QUALITY

- A. Pre-Construction Record: Quality shall be such that the condition of existing pavement, curbing, driveway entrances, sidewalks, walls, doors, equipment, piping, etc. can be readily determined.
- B. Construction Record: Quality shall be such that the progress of the work is satisfactorily documented. Construction record photographs shall be taken by a professional photographer acceptable to the Engineer.
- C. Post-Construction Record: Aerial photographs shall be taken by a professional aerial photographer acceptable to the Engineer. Electronic files shall be high resolution digital images.

1.3 SUBMITTAL OF PRINTS

A. Pre-Construction Record:

1. Submit pre-construction photographs/videos in accordance with Section 01340 prior to initiating any work on-site.
2. Submit electronic files on thumb drive or external drive to the Engineer and Owner prior to any construction work.

B. Construction Record:

1. Submit construction record photographs/videos in accordance with Section 01340 concurrent with the monthly payment requisition.
2. Submit electronic files on thumb drive or external drive to the Engineer..

C. Post-Construction Record:

1. Submit post-construction record aerial photographs in accordance with Section 01340 prior to final payment requisition.
2. Submit color proofs of aerial photographs for review. Owner will select one proof for prints. Submit two 11"x14" prints and one 16"x 20" print. All three prints shall be mounted in metal frames with glass.

D. The quality of the photos and video are subject to approval by the Engineer.

- E. Photographs and videos taken for the project and submitted are released to the Owner and Engineer for reproduction and use for records retention, governmental and commercial purposes.

END OF SECTION

SECTION 01400QUALITY CONTROLPART 1 - GENERAL1.1 REQUIREMENTS INCLUDED

- A. General Quality Control.
- B. Workmanship.
- C. Manufacturer's Instructions.
- D. Manufacturer's Certificates.
- E. Manufacturer's Field Services.
- F. Testing Laboratory Services.

1.2 RELATED REQUIREMENTS

- A. Section 01340 - Submittals: Submittal of Manufacturer's Instructions
- B. Section 02501 – Removal and Replacement for Paving, Curbing and Sidewalks

1.3 QUALITY CONTROL

- A. Maintain quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

1.4 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.5 MANUFACTURERS' INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence. Should instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

1.6 MANUFACTURERS' CERTIFICATES

- A. When required by individual Specifications Section, submit manufacturer's certificate that products meet or exceed specified requirements.

1.7 MANUFACTURERS' FIELD SERVICES

- A. When specified in respective Specification Sections, require supplier and/or manufacturer to provide qualified personnel to observe field conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to make appropriate recommendations.
- B. Representative shall submit written report to Engineer listing observations and recommendations.

1.8 TESTING LABORATORY SERVICES

- A. Owner will employ and pay for services of an Independent Testing Laboratory to perform inspections, tests, and other services wherever an Independent Testing Laboratory is required by individual specification sections listed in paragraph 1.2 above, unless otherwise indicated.
- B. Services will be performed in accordance with requirements of governing authorities and with specified standards.
- C. Reports will present observations and test results and indicate compliance or non-compliance with specified standards and with Contract Documents. Independent Testing Laboratory will submit one copy of each report directly to each of the following: Engineer, Resident Project Representative, Contractor. Reports will be submitted within 5 days of obtaining test results. If test results indicate deficiencies, Independent Testing Laboratory shall telephone or email results to Engineer, Resident Project Representative and Contractor within 24 hours.
- D. Contractor shall cooperate with Independent Testing Laboratory personnel; furnish tools, samples of materials, design mix, equipment, storage and assistance as requested.
- E. Contractor shall notify Engineer at least one full working day prior to needing testing laboratory services. Engineer will notify Independent Testing Laboratory. If scheduled tests or sampling cannot be performed because the work is not ready as scheduled, testing costs associated with the delay will be determined by Engineer and invoiced by Owner to Contractor. If unpaid after 60 days, the invoice amount will be deducted from the Contract Price. If adequate notice is not provided, Contractor shall suspend work on that portion of the Project until testing can be performed. Such suspension will not be grounds for a claim against the Owner for delay, nor will it be an acceptable basis for an extension of time.
- F. Payment for Independent Testing Laboratory services shall be as follows:
 - 1. General: Where testing is the Owner's responsibility, payment will be made as stated below unless other requirements are given in Specification Sections. Testing which is the responsibility of the Contractor will be considered an incidental item unless otherwise indicated in Section 01150, Measurement and Payment.
 - 2. Initial Testing: Owner will pay for initial tests.
 - 3. Retesting: Costs of retesting due to non-compliance will be paid by Owner. The cost of retesting will be determined by Engineer and Owner will invoice Contractor for this cost. If unpaid after 60 days, the invoice amount will be deducted from the Contract Price.
 - 4. Contractor's Convenience Testing: Inspections and tests performed for Contractor's convenience will be paid for by Contractor.

END OF SECTION

SECTION 01500TEMPORARY FACILITIES AND CONTROLSPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. Provide and pay for all temporary utilities required to properly perform the Work at no additional cost to the Owner including the placement and removal of the utilities.
2. Completely remove all temporary equipment and materials upon completion of the Work and repair all damage caused by the installation of temporary utilities.
3. Make all necessary applications and arrangements for electric power, light, water and other utilities with the local utility companies. Notify the local electric power company if unusually heavy loads, such as welders, will be connected.
4. Provide temporary protection of existing concrete tanks and other unheated concrete structures taken out of service for the General Contractor to complete the Work as indicated on the Contract Documents in that area.
5. Contractor shall provide temporary ventilation during construction as required to ensure a safe working environment. The temporary ventilation systems shall address the following conditions, including but is not limited to: removal of hazardous fumes from explosion-proof rated spaces (Class 1, Division 1 rated spaces), removal of paint fumes and other potentially toxic conditions associated with the contractor's activities, and ventilation of confined spaces, in compliance with all OSHA and State safety requirements.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Obtain permits as required by local governmental authorities.
2. Obtain easements, when required, across private property other than that of the Owner for temporary power service.
3. Comply with the latest National Electrical Code.
4. Comply with all local, State and Federal codes, laws, and regulations.

B. All temporary utilities are subject to the approval of the Engineer.

PART 2 - PRODUCTS2.1 MATERIALS

A. Electrical:

1. The General Contractor shall make necessary arrangements with the local power company for connection to the existing power supply and shall provide and pay for all temporary light and power requirements except as otherwise specified hereunder. In general, the temporary electrical service shall include all necessary switches, poles, wiring, cables, conduit, raceways, panelboards,

fixtures, lamps and receptacles to supply construction power of adequate capacity for the project. Temporary transformers and meters shall be furnished and installed by the appropriate power authority, but paid for by the General Contractor, who shall be responsible for making all arrangements for their installation prior to using any existing power for temporary purposes.

2. Use new or used materials adequate in capacity for the purposes intended.
 3. Materials must not create unsafe conditions or violate the requirements of applicable codes.
 4. Conductors:
 - a. Wire, cable or busses of appropriate type, sized in accordance with the latest National Electrical Code for the applied loads.
 - b. Use only UL approved wire.
 5. Conduit:
 - a. Rigid steel, galvanized: ANSI C80.1.
 - b. Electrical metallic tubing: ANSI C80.3.
 - c. Other material approved by NEC.
 6. Equipment: Provide appropriate enclosures for the environment in which used in compliance with NEMA Standards.
 7. Temporary power shall be based upon the following minimum requirements:
 - a. Lighting - 300 watt per 1,000 square feet of floor area.
 - b. Receptacles - One 15 ampere duplex for 1,000 square feet of floor space.
 8. Special Construction Equipment - Provide one 30-amp, 2-pole fused switch for equipment connection. The cost for cables and connection from switch to the special equipment will be borne by the Sub-Contractor requiring same.
 9. The General Contractor will pay for the cost of energy consumed by all trades, including cost of lamp replacement. The General Contractor and Subcontractors of all trades shall furnish their own extension cords and such additional lamps as may be required for their work, shall pay for the cost of temporary wiring of a special nature for light and power required, other than that above mentioned.
 10. All temporary work shall be furnished and installed in conformity with the National Electrical Code and in accordance with local ordinances and requirements of the municipal power authority. All temporary wiring and accessories shall be removed after it has served its purpose.
- B. Heating and Ventilation:
1. The General Contractor shall furnish, install, and maintain a complete temporary heating and ventilation systems, including fuel therefore, which will provide heat and ventilation as required by the trades and for the protection of personnel in the work spaces, and stored and installed materials from injury as can be caused by dampness and cold. The General Contractor shall employ, within the terms of the General Contract, a competent watchman who will maintain and operate the systems, as required. The General Contractor shall bear all costs incurred from the temporary heating and ventilation from the time the systems are first required until the date of Substantial Completion of the General Contract, as defined in the General Conditions and Supplementary Conditions.

2. Under no circumstance shall the permanent heating system be used for temporary heating purposes, until the building/buildings have been considered as satisfactorily enclosed by the Engineer, specified hereunder.
 3. Temporary heating equipment must be smokeless and fumeless type, Underwriters Laboratories, Factory Mutual, Fire Marshal and Engineer approved, and will fulfill the heating requirements specified hereunder.
 4. As soon as practicable, after the building/buildings have been considered satisfactorily enclosed by the Engineer, the General Contractor shall have the permanent heating and ventilation systems and apparatus put in operation. Electrical service, wiring, controls, and other essential parts of the permanent system must be installed prior to utilizing the heating system. The General Contractor shall pay for all power and fuel consumed in the temporary operation of the permanent systems until the time the building/buildings are partially or permanently occupied by the Owner, whichever comes first in accordance with the provisions specified herein for use and occupancy prior to acceptance by the Owner.
 5. The General Contractor shall reimburse the Heating and Ventilating Sub-Contractor for labor required to be provided by the Sub-Contractor.
 6. Any adjustments to the permanent system shall be performed under the work of the trade Sections installing same and costs for same shall be borne by the respective trades. The General Contractor shall reimburse the Heating and Ventilating Sub-Contractor for costs involved in completely cleaning the permanent system, replacing all temporary filters and other temporary items used in conjunction with the permanent heating system, and otherwise required to put the system into new condition, just prior to occupancy of the project by the Owner.
 7. After enclosure of the building/buildings and before installation of wet work such as interior masonry and tile, maintain temperatures of 50 degrees minimum, except for a period commencing 10 days prior to the installation of interior woodworking, interior flooring, or interior painting, whichever occurs first, after which time the temperature shall be maintained at a minimum of 65 degrees F., until the project is either partially or permanently occupied by the Owner.
- C. Water and Sanitary:
1. The General Contractor shall make necessary arrangements for connection to the municipal water supply and shall provide, at their own expense, any extensions as required for the operation of this project. The General Contractor shall bear all costs incurred for the temporary water services, including the costs of the water itself.
 2. All lines, temporary or permanent, shall be protected and maintained by the General Contractor. Temporary lines shall be removed by the General Contractor when the temporary service is no longer required.
 3. The General Contractor shall provide an adequate drinking water supply, satisfactorily cooled, for their employees.
 4. See Site Plan for nearest water hook-up.

5. The General Contractor shall furnish, install, maintain and pay for adequate temporary chemical type toilet accommodations, for all persons employed on the work and located where approved by the Engineer. The accommodations shall be in proper enclosures and in accordance with Municipal Ordinances and shall be maintained in proper, safe and sanitary conditions and suitably heated when requested.
 6. Relocate temporary toilet facilities as required to facilitate the construction.
 7. Remove all temporary facilities at completion of work when directed by the Engineer.
- D. Protection of Existing Concrete Tanks and other Unheated Concrete Structures taken out of Service:
1. The General Contractor shall provide protection as required to maintain the surface temperatures of the existing concrete above 40 degrees F during the months of November through March and other periods during which the ambient air temperature is below 32 degrees F. The General Contractor shall be responsible for all means and methods to maintain the specified temperature at no additional cost to the Owner.
 2. The General Contractor shall furnish and monitor surface thermometers on the concrete surfaces.
 3. The above listed requirement is a minimum required to prevent the structure from freezing. If the nature of the work within the structure requires a greater air temperature to perform the work (such as application of coatings), the requirements of Part 2.1.B shall apply.
 4. If, in the opinion of the Engineer, the work required in the unheated structure is of a short duration or the anticipated ambient air temperatures will not drop below 40 degrees F, additional protection as required in Part D.1 may not be required. The General Contractor shall still be responsible for monitoring the temperature of the concrete surfaces and providing protection if they drop below 40 degrees F.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Electrical:

1. Provide electrical energy to:
 - a. All necessary points on the construction site so that power can be obtained at any desired point with extension cords no longer than 100 feet.
 - b. Construction site offices.
 - c. Lighting as required for safe working conditions at any location on the construction site.
 - d. Night security light.
 - e. When applicable, Owner's present facilities during the changeover of electrical equipment.
 - f. Temporary bypass pumping equipment.
2. Maintain electrical energy throughout the entire construction period.

3. Capacity:
 - a. Provide and maintain adequate electrical service for construction use by all trades during the construction period at the locations necessary, as specified herein.
4. Installation:
 - a. Install all work with a neat and orderly appearance.
 - b. Have all installations performed by a qualified electrician.
 - c. Modify service as job progress requires.
 - d. Locate all installations to avoid interference with cranes and materials handling equipment, storage areas, traffic areas and other work.
- B. Heating and Ventilation:
 1. Maintain a heated and ventilated environment for the work at the temperature and for the length of time specified or as directed by the Engineer, and as needed to protect all individuals on the construction site.
 2. Precaution:
 - a. Operate temporary heating apparatus in such a manner that finished work will not be damaged.
 - b. Repair all damage, caused by temporary heating operations, to the complete satisfaction of the Engineer.
- C. Water:
 1. Provide and maintain water for drinking and construction purposes as required for the proper execution of the Work.
- D. Sanitary Accommodations:
 - a. Provide and maintain sanitary accommodations for the use of the employees of the General Contractor, subcontractors, and Engineer.
 - b. Sanitary accommodations shall meet the requirements of all local, State and Federal health codes, laws and regulations.
- E. Protection of Existing Tanks and other Unheated Structures taken out of Service:
 1. The General Contractor shall provide protection and/or heat as required to maintain the specified temperature of the existing structure.
 2. The General Contractor shall document the condition of the structures immediately after they are taken out of service with either still photos or video.
 3. Precaution:
 - a. If additional heat is required, operate temporary heating apparatus in such a manner that the existing structure will not be damaged.
 - b. Repair all damage, caused by temporary heating operations, to the complete satisfaction of the Engineer.
 4. The General Contractor shall repair any concrete damaged as a result of the surface temperatures of the concrete dropping below 40 degrees F.

END OF SECTION

SECTION 01515TEMPORARY BYPASS PUMPING SYSTEMSPART 1 - GENERAL1.1 DESCRIPTION

- A. The Contractor shall furnish, install, operate, maintain and remove the temporary bypass pumping system at each pump station as required. The temporary system shall be able to reliably pump all incoming, raw, unscreened wastewater flows as scheduled herein. The temporary bypass pumping system shall be provided in order allow for the existing facilities to be shut down during the upgrade of the process, mechanical and electrical facilities.
- B. The Contractor may utilize the available an onsite manholes to draw sewage from. The bypassed flow will be discharged into a new bypass pumping connection to be constructed as part of this project or a temporary bypass pumping connection if the permanent connection requires a bypass to be constructed prior.
- C. For short bypass durations, such as to install the force main bypass connection, tanker trucks can be used if the work is conducted at night, or during extreme low flow periods coordinated and approved by the Owner.
- D. The Contractor shall coordinate temporary bypass pumping with the Owner on a daily basis. The Contractor is required to report alarm conditions immediately to the Owner by use of a teledialer (phone/pager numbers to be provided by Owner). The Contractor shall furnish and maintain communication equipment, including teledialer, cellular telephones and two-way radios, to maintain communication on-site.
- E. The Contractor shall annunciate and log alarm conditions including high water level in the wetwell or upstream manhole and loss of primary pump. The alarm log shall include the type of alarm, time of alarm, time alarm acknowledged, and time alarm condition cleared.

1.2 RELATED WORK

- A. Section 01010 - Summary of Work
- B. Section 01340 - Submittals

1.3 SUBMITTALS

- A. Submit the following in accordance with Section 01340 and as specified herein.
 - 1. Proposed sequence of construction.
 - 2. Coordination Drawings showing detailed layout of equipment, pumps, suction and discharge piping, piping fittings, valves, supports, materials, temporary enclosure and temporary odor control provided under this section. Provide catalog cut sheets/ technical data for equipment and appurtenances.
 - 3. List of equipment, pumps, piping, fittings, valves, and materials to be utilized by the Contactor for the temporary bypass pumping system.
 - 4. List of standby equipment and spare parts available on-site and off-site.
 - 5. Performance curves for wastewater bypass pumps and suction lift, static head,

- headloss, and total dynamic head (TDH) calculations.
6. List of contact persons and communications equipment to be utilized.

PART 2 - PRODUCTS

2.1 WASTEWATER BYPASS PUMPING SYSTEM

A. General:

1. The Contractor shall furnish, install, operate, maintain and remove a wastewater bypass pumping system that will be capable of handling the following estimated range of flows, which includes infiltration and inflow.

Old Norwich Road Pump Station		
CONDITION	FLOW	
	MGD	GPM
Average Day	<i>0.15</i>	<i>100</i>
Peak	<i>0.5</i>	<i>350</i>

2. The bypass pumping system shall include a variable speed electrically driven lead pump with diesel driven back-up pump(s). All pumps shall be critically silenced to less than 68 decibels at 25 feet. Each pump shall be a skid-mounted unit.
3. The pump priming system shall be fully automatic, needing no form of adjustment or manual addition of water. The priming system shall be capable of priming the pump from a completely dry casing.
4. The pumps shall be centrifugal trash pumps suitable for handling raw, unscreened sewage with solids up to 3 inches in diameter, and capable of running completely dry for extended periods of time without damage. Pumps shall be capable of static suction lifts up to 28 vertical feet, at sea level. Deeper manholes may require the contractor to excavate down and install the pump sets at a lower elevation.
5. The pumpset shall be furnished with float or transducer level controls, and be equipped with a weatherproof, controller. The controller shall start/stop the pumps based on signals from high and low level floats or a transducer. The controller shall be capable of automatically varying the pump speed to match varying flow conditions and maintain a constant level at the Influent Manhole or wetwell.
6. Contractor to provide portable spill guard containment dikes for supplied pumps.
7. Bypass pumping systems shall be Dri-Prime diesel driven pumpsets as supplied by Godwin Pumps, Manchester, New Hampshire; Baker Corp, Oxford, Massachusetts; or equal.
8. The services of a representative of the bypass pumping system supplier shall be provided to inspect the installation and supervise the startup and testing of the system.

9. The Contractor shall operate and maintain the bypass pumping system at all times.

PART 3 - EXECUTION

3.1 GENERAL:

- A. The temporary bypass pumping system shall be furnished, installed, operated, maintained and removed as follows:
 1. The Contractor shall coordinate all Work as specified in Paragraph 3.2.
 2. The Contractor shall furnish, install, and test temporary bypass pumping system and discharge pipelines. Discharge piping shall be constructed of rigid galvanized steel pipe with ball and socket joints, Bauer HK Quick Coupling Piping or equal. Connection to the new Bypass Pumping Connection shall be by Class 53 Ductile Iron piping, as shown on the Drawings. Aluminum "irrigation" type piping or glued PVC pipe shall not be allowed.
 3. The Contractor shall test and debug all systems and verify that all necessary equipment, materials, spare parts, and labor are available on-site prior to operation of the system and prior to the demolition of any part of the existing pumping station facilities.
 4. The Contractor shall be responsible for costs and labor for fuel/fuel filling and all electrical costs including temporary power if required and cost of electricity for operating the system. All costs shall be included in the base bid.
 5. The Contractor shall operate and maintain the system until the new electrical upgrade facilities are completed, demonstration tested and accepted by the Owner and Engineer.
 6. Upon receipt of approval by the Owner and Engineer, the Contractor shall remove the temporary bypass pumping system, including all appurtenant piping. Contractor shall restore the area impacted by the temporary bypass pumping system to a like-new condition.

3.2 COORDINATION OF WORK

- A. Provide all labor and equipment necessary to coordinate work of this section and maintain communications.
- B. Notify all personnel seven days in advance of any temporary bypass pumping work. The Owner will identify personnel to be notified in addition to those identified by the Contractor.

END OF SECTION

SECTION 01600

DELIVERY, STORAGE AND HANDLING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies the general requirements for the delivery, handling, storage and protection for all items required in the construction of the work. An updated delivery and storage log is required with the monthly payment requisition prior to approval. An example log is included in this section.
- B. Related Items:
 - 1. Section 01800: Equipment Start-Up, Certification and Operator Training.
 - 2. Section 11000: Equipment - General.

1.2 TRANSPORTATION AND DELIVERY

- A. Transport and handle items in accordance with manufacturer's instructions.
- B. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than 120 days prior to installation without written authorization from the Engineer.
- C. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for the protection of components.
- D. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended, including cross reference of the applicable contract specification section.
- E. Deliver spare parts at the same time as pertaining equipment. Deliver spare parts to the Owner after completion of work.
- F. Deliver products to the site in manufacturer's original sealed containers or other packing system, complete with instructions for handling, storing, unpacking, protecting and installing.
- G. Instructions for handling, storing, unpacking, protecting and installing equipment shall be included in the Equipment O&M Manuals, which shall be submitted prior to the equipment being shipped to the site. This information shall be filed in a dedicated three ring binder(s) on-site, in the Contractor trailers, accessible to the Owner and Engineer. The binder(s) shall be clearly labeled and include dividers for each specification section. The manufacturer-provided instructions for each equipment item shall be labeled with the specification number, equipment name, and equipment number. The instructions shall also be submitted to the Engineer.
- H. Assume responsibility for equipment material and spare parts just before unloading from carrier at site.
- I. All items delivered to site shall be unloaded and placed in a manner which will not hamper the Contractors normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.
- J. Provide equipment and personnel to unload all items delivered to the site.
- K. Promptly inspect shipment to assure that products comply with requirements, quantities are correct, and items are undamaged. For items furnished by others (i.e.,

Owner, other Contractors), perform inspection in the presence of the Engineer.
Notify the Engineer in writing of any problems.

- L. Pay all demurrage charges if failed to promptly unload items.

1.3 STORAGE AND PROTECTION

- A. Store and protect products and equipment in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instructions shall be studied by the Contractor and reviewed with the Engineer by them. Instructions shall be carefully followed and a written record of this kept by the Contractor for each product and pieces of equipment.
- B. Arrange storage of products and equipment to permit access for inspection. Periodically, inspect to make sure products and equipment are undamaged and are maintained under specified conditions.
- C. Provide protective maintenance during storage consisting of manually exercising equipment, inspecting mechanical surfaces for signs of corrosion or other damage, lubricating, applying any coatings as recommended by the equipment manufacturer necessary for its protection and all other precautions to assure proper protection of all equipment stored and for compliance with manufactures requirements related to warranties.
- D. Store loose granular materials on a solid flat surface in a well-drained area. Prevent mixing with foreign matter.
- E. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous and reinforcing steel shall be stored off the ground or otherwise to prevent accumulation of dirt or grease, and in a position to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, cracking and spalling to a minimum.
- F. All mechanical and electrical equipment and instruments shall be covered with canvas and stored in a weather tight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it shall be satisfactory to the Engineer.
 - 1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by manufacturer.
 - 2. Moving parts shall be rotated at a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Log all rotation maintenance for each piece of equipment in the written record noted above.
 - 3. Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use. Log all startup for each piece of equipment in the written record noted above.
 - 4. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.
 - 5. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the

manufacturer to be in condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guarantee the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

- G. The weather tight building shall be provided with adequate heating/cooling and ventilation as required by the manufacturer to prevent condensation. Maintain temperature and humidity within range required by manufacturer and to prevent condensation on the equipment being stored.
- H. Temporary heating and cooling is acceptable. Equipment shall be protected from environmental effects as required by the manufacturer and dependent on the season. Equipment that arrives on site without coating shall be protected from environmental impacts through coating or protection at the Contractor's expense. Any equipment that displays defects or corrosion from environmental impacts will not be accepted for installation.
- I. The location of all stored material and equipment shall be reviewed with the Owner and Engineer. The Owner and Engineer may request that equipment and material be moved to an alternate location to accommodate plant maintenance and operation, or if the location is deemed unacceptable or unsuitable.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING MONTHLY LOG

- A. An updated storage and delivery log is required with the monthly payment requisition prior to approval.
- B. The monthly log shall include the specification section, equipment description, equipment tagging, submittal approval date, date of equipment delivery, date of O&M submittal, contractor start-up sign-off, certified equipment testing date, operator training date, spare parts turnover date, required maintenance (activity and date), and equipment turnover (Owner's witness and date).

3.2 STORAGE AND PROTECTION

- A. Equipment requires acceptance and verification of the storage from the Owner, Engineer, Manufacturer and Contractor at the Engineer's discretion.
- B. Following delivery, the equipment warranty from the Manufacturer is the responsibility of the Contractor.
- C. All storage and maintenance will be the responsibility of the Contractor, conducted at the Contractor's expenses and verified by the Engineer.
- D. It is the Contractor's responsibility to coordinate all storage requirements on site as required by the Manufacturer to achieve acceptance.

Section 01600 Delivery, Storage and Handling

[illegible]

1. If equipment is delivered and placed in storage, all steps for Stored Equipment shall be followed and tracked separately
2. Log weekly start-ups of installed equipment, performed by Contractor, until Equipment Turnover

END OF SECTION

SECTION 01710

PROJECT CLEANING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Maintain premises and public properties free from accumulations of waste, debris, and rubbish, caused by operations.
2. At completion of work, remove waste materials, tools, equipment, machinery and surplus materials, and clean all sight-exposed surfaces. Leave project clean and ready for use.

1.2 QUALITY ASSURANCE

- ###### A. Requirements of Regulatory Agencies:
- Conduct cleaning and disposal operations in accordance with all applicable local and state laws, ordinances, and code requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- ###### A. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.
- ###### B. Use cleaning materials only on surfaces recommended by cleaning material manufacturers.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Cleaning During Construction:

1. Execute cleaning operations to ensure that buildings, grounds, and public properties are maintained free from accumulations of waste materials and rubbish.
2. Entirely remove and dispose of material or debris during the progress of the work that has washed into or has been placed in watercourses, ditches, gutters, drains, catch basins, or elsewhere as a result of the Contractor's operations.
3. Wet down dry materials and rubbish to lay dust and prevent blowing dust.
4. At reasonable intervals during the progress of work, clean the site and dispose of waste materials, debris, and rubbish.
5. Clean interiors of buildings, when applicable, prior to finish painting, and continue to clean on an as-needed basis until buildings are ready for occupancy.
6. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw material from heights.
7. When applicable, schedule cleaning operations so that dust and other contaminants resulting from the cleaning process will not fall on wet, newly painted surfaces.

- B. Control of Hazards:
 - 1. Store volatile wastes in covered metal containers and remove from premises daily.
 - 2. Prevent accumulation of wastes which may create hazardous conditions.
 - 3. Provide adequate ventilation during use of volatile or noxious substances.
- C. Disposal:
 - 1. Do not burn or bury rubbish and waste materials on project site.
 - 2. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.
 - 3. Do not dispose of wastes into streams or waterways.
- D. Final Cleaning:
 - 1. Employ experienced workers, or professional cleaners, for final cleaning.
 - 2. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials, from all sight-exposed interior and exterior finished surfaces.
 - 3. Repair, patch and touch up marred surfaces to specified finishes.
 - 4. Broom clean paved surfaces.
 - 5. Rake clean non-paved surfaces of the project site.
 - 6. Restore to their original condition those portions of the site not designated for alterations by the Contract Documents.

END OF SECTION

SECTION 01720PROJECT RECORD DOCUMENTSPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. Keep accurate record documents for all additions, demolition, changes of material or equipment (from that shown on the Drawings), variations in work, and any other additions or revisions to the Contract (via Change Order, Work Change Directive, Field Order or Clarification).

B. Related Work Specified Elsewhere:

1. Shop Drawings, Project Data, and Samples are specified in "General Conditions" and Section 01340, Submittals.
2. Electrical System Record Drawing requirements are outlined in Division 16.

1.2 MAINTENANCE OF DOCUMENTS

A. Maintain at job site, one copy of:

1. Contract Drawings
2. Specifications
3. Addenda
4. Reviewed Shop Drawings
5. Change Orders
6. Any other modifications to the Contract
7. Field Test Reports

B. Store documents in files and racks specifically identified for Record Drawing use, that are apart from documents used for construction.

C. File documents in a logical manner indexed for easy reference.

D. Maintain documents in clean, dry, legible condition.

E. Do not use record documents for construction purposes.

F. Make documents available at all times for inspection by the Engineer and Owner, and by the end of the project, transmit these documents to the Engineer.

G. Failure to maintain current records, as specified herein, shall be grounds for withholding additional retainage from monthly partial payment requests.1.3 RECORDING

A. Label each document "PROJECT RECORD" in large high printed letters.

B. Keep record documents current and do not permanently conceal any work until required information has been recorded.

C. General Field Recording Issues:

1. All swing ties shall be taken from existing, permanent features such as utility poles, corners of buildings and hydrants. Porches, sheds or other house additions shall be avoided as they could be torn down. A minimum of two swing ties shall be taken. Survey grade GPS coordinates are also acceptable.
2. Stations shall be recorded to the nearest foot.

3. Inverts shall be recorded to the nearest hundredth of a foot.
 4. Elevations shall be recorded to the nearest hundredth of a foot.
 5. Building dimensions shall be recorded to the nearest 1/4".
 6. Equipment and Piping shall be recorded to the nearest tenth of a foot, and the overall dimensions and layout of the equipment shall be adjusted to reflect the equipment provided.
- D. Project Record Drawings - Legibly mark Contract Drawings to record existing utilities and actual construction of all work, including but not limited to the following (where applicable):
1. Existing Utilities
 - a. Water mains and services, water main gate valves, sewer mains and services, storm drains, culverts, steam lines, gas lines, tanks and other existing utilities encountered during construction must be accurately located and shown on the Drawings. In congested areas supplemental drawings or enlargements may be required.
 - b. Show any existing utilities encountered in plan and profile and properly labeled showing size, material and type of utility. Ties shall be shown on plan. Utility shall be drawn to scale in section (horizontally and vertically) and an elevation shall be called out to the nearest hundredth of a foot.
 - c. When existing utility lines are broken and repaired, ties shall be taken to these locations.
 - d. If existing water lines are replaced or relocated, document the area involved and pipe materials, size, etc. in a note, and with ties.
 2. Manholes, Catch Basins, Valve Pits and other structures.
 - a. Renumber structure stationing to reflect changes.
 - b. Show ties to center of structure covers or hatches.
 - c. In general, show inverts at center of structures. However, for manholes with drop structures, or steep channels (greater than 0.2' change on slope), show inverts at face of manhole.
 - d. Show inverts for other structures at the face of the structure.
 - e. Draw any new structures that are added on plan and profile.
 - f. Show any field or office redesigns.
 - g. Redraw plan if the structure's location is moved more than 5 feet in any direction. Note: It is important to show existing utilities, as outlined in Paragraph 1 above, especially if they were one reason for relocating the sewer, manholes, and other structures.
 - h. Redraw profile if inverts changed by more than 6 inches.
 3. Gravity Sewer Line
 - a. Change sewer line slopes indicated on Drawings if inverts are changed.
 - b. Draw any new gravity lines that are added on plan and profile.
 - c. Show any field or office redesigns.
 - d. Redraw the sewer line profile if manhole inverts are redrawn.
 - e. Redraw the sewer line on plan corresponding to relocated manholes.
 4. Water Mains and Force Mains
 - a. Show ties to the location of all valves, bends (horizontal and vertical), tees and other fittings. The use of thrust blocks shall be recorded.

- b. Revise elevations indicated on the Drawings to reflect actual construction.
- 5. Ledge
 - a. Ledge profiles shall be shown. Note whether the plotted ledge profile reflects undisturbed or expanded conditions.
- 6. Yard Piping and Buried Electrical Conduit
 - a. Site piping and utilities shall be drawn to reflect the installed locations, with ties and elevation of all bends (horizontal and vertical).
 - b. Show routing for electrical conduits and pull boxes, especially in close proximity to buildings and when the conduits change direction or cross process piping.
- 7. Roads
 - a. Show centerline road profile and level spot elevations.
 - b. Show pavement widths.
 - c. On road cross sections, show the pavement cross slope.
 - d. Show any deviations from the design plans.
- 8. Buildings
 - a. In general, small changes to structures shall not be redrawn. If any dimensional changes were made in the field, the numerical change shall be made on the Drawing and be properly labeled. Update dimensions and elevations on Drawings.
 - b. Show finished concrete elevations (top of slab, top of wall, top of footing, etc.). Redraw any foundation, frost wall, etc. that was modified, deepened, or altered during construction.
 - c. Adjust finished concrete horizontal dimensions that are shown on the Drawings.
 - d. Adjust structural steel elevations and horizontal dimensions that are shown on the Drawings.
 - e. Show location of anchors, construction and control joints, and waterstops, when they are different from those shown on Drawings.
 - f. Any additions or major changes shall be shown in both plan and elevation (i.e. relocated doors, opposite door swings, change in wall location, relocation of floor drains).
 - g. Show approximate location and routing of electrical conduits in walls, slabs and ceilings. Most conduits are run in groups, therefore, use range of measurements to define location for entire section of conduits.
 - h. Special circuits for computers, alarms and instrumentation shall be shown.
 - i. Show any changes in location and elevation of ductwork and devices, fuel piping and equipment, and heat piping and equipment.
 - j. Location of gravity sewer system below slabs in buildings shall be shown, if changes are made in the configuration.
 - k. If wall mounted electrical switches, control boxes, thermostats, etc. have been relocated significantly, (other side of door, or to a wall other than indicated diagrammatically on electrical plans) make the revision accordingly.
- 9. Utilities

- a. When encountered, additional utilities (e.g., gas, cable, telephone, fiber optic, etc.) shall be indicated on the Record Drawings.
- 10. Equipment Systems and Piping
 - a. Show any changes to equipment systems, whether interior or exterior, for process, HVAC, plumbing, instrumentation or electrical. If any dimensional changes were made in the field, the numerical change shall be made on the Drawing and be properly labeled. Update dimensions and elevations on Drawings. Record Drawings must reflect any equipment configuration and layout changes differing from that shown on the Drawings.
 - b. Show any changes to piping systems, whether interior or exterior, for process, HVAC, plumbing and instrumentation. If any dimensional changes were made in the field, the numerical change shall be made on the Drawing and be properly labeled. Update dimensions and elevations on Drawings.
- E. Specifications and Addenda - Legibly mark up each section to record:
 - 1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 - 2. Changes made by Change Order, Field Order, or other method.

1.4 SUBMITTALS

- A. At the completion of the project, and prior to the release of retainage, deliver record documents to the Engineer.
 - 1. Record drawings shall be provided as a bound, red-line paper set.
 - 2. Record drawings shall be provided as a bound, red-line paper set and an electronic file (pdf format) consisting of a full scan of the bound paper set.
 - 3. Record drawings shall be provided as a bound paper set of computer generated drawings, an electronic file (pdf format) of the bound paper set, and electronic files in AutoCAD format. Ownership of the drawings and files shall pass to the Owner at the time of submittal.
 - 4. Record drawings shall be provided as electronic files in ESRI GIS format. Ownership of the drawings and files shall pass to the Owner at the time of submittal.
 - 5. If the Contractor provides alternate or substitute equipment that requires revised arrangements from the Bidding Documents, the Contractor shall provide supplemental record drawings of these items in AutoCAD format.
- B. Accompany submittal with transmittal letter, in duplicate, containing:
 - 1. Date, project title and number.
 - 2. Contractor's name and address.
 - 3. Title and number of each record document with certification that each document is completed and accurate.
 - 4. Signature of Contractor, or their authorized representative.
- C. Failure to supply all information on the Project Record Drawings as specified in Part 1.3 may result in withholding final completion and in non-approval of final payments of the Contract. If Contract Time has elapsed, this shall be grounds for imposing liquidated damages.

1.5 QUALITY ASSURANCE

- A. All horizontal and vertical dimensions, swing-ties, and elevations shall be accurate to within one-tenth of a foot, unless greater accuracy is specified elsewhere in the Specifications (e.g., concrete elevations, weir elevations, etc.).

PART 2 - PRODUCTS – NOT APPLICABLE

PART 3 - EXECUTION

3.1 MAINTAINING AND PROVIDING RECORDS

- A. Records shall be kept current as the work progresses.
- B. Records shall be made available for review by the Owner, Engineer, Resident Project Representative and/or Funding Agency(s) upon request.
- C. Records shall be kept current as the work progresses. Failure to maintain current records, as specified herein, shall be grounds for withholding additional retainage from monthly partial payment requests. Failure to provide records shall also be grounds for withholding of final payment and, if beyond contract time, shall be grounds for imposing liquidated damages.

3.2 AS-BUILT SURVEY PERFORMANCE

- A. From established survey control, and construction baseline as shown on the drawings, conduct surveys of the project area during construction as needed to obtain information of buried and above ground items. Surveys shall include information outlined in Section 1.3.
- B. Actual road alignments; walls; fence and guardrail; existing, new and relocated utility poles; traffic and warning sign locations; crosswalks, parking space and stop bar locations; retaining walls and foundations drains; all underground and overhead utility poles and lines within the project limits, including those installed on private property; all other new features and appurtenances and those existing features and appurtenances changed as a result of this project shall be included in the survey.

3.3 FORMAT FOR ELECTRONIC DELIVERABLES

- A. AutoCAD digital survey data for the as-built survey shall include:
 - 1. Copy of field notes and sketches of the survey.
 - 2. Paper copy of description of layers.
 - 3. Paper copy of base map.
 - 4. Provide digital information on compact disk with paper copy printout; information shall be provided in .DWG format (AutoCAD 2011 or earlier). Data shall be provided in 3D format (northing, easting, elevation, or Y, X, Z).
 - 5. Drawing scale: Minimum one inch = twenty feet.
 - 6. Layering:
 - a. Repetitive symbols made into blocks and defined on layer 0.
 - b. All entities shall be drawn “by layer” as opposed to individual properties.
 - c. Use one linetype and one color per layer as opposed to numerous colors/linetypes on a single layer.
 - d. Preface each layer with the initials of the Survey company or Contractor (example, Survey Company: SC “layername”).

- e. Database text annotation will be coordinated so the text will be right-reading.
- f. Place text on separate layers.

END OF SECTION

SECTION 01800EQUIPMENT STARTUP, TESTING AND OPERATOR TRAININGPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. General: The work of this Section includes the startup, certification and operator training of equipment and control systems sufficient for a fully functional project as determined by the Engineer. The following steps are integral to this process:
 - a. Submittals, as specified in Section 01340.
 - b. Operations and Maintenance Manuals, as specified in Section 01340.
 - c. Summary of Work/ Construction Sequencing as specified in Section 01010.
 - d. Temporary Facilities and Controls as specified in Section 01500.
 - e. Temporary Bypass Pumping Systems as specified in Section 01515.
 - f. Pre-Startup Meeting, as specified herein.
 - g. Factory Acceptance Testing, as specified in Division 13.
 - h. Equipment Startup, as specified herein.
 - i. Operator Training, as specified herein.
 - j. Equipment Demonstration Testing, as specified herein.
 - k. Site Acceptance Testing, as specified in Division 13.
 - l. One Year Service Calls, as specified herein.

B. General Definitions:

1. Equipment Startup shall be generally defined as the initial placing into service of the equipment by representatives of the Contractor, any subcontractors directly responsible for the equipment provided, and the equipment Manufacturer. This shall include verification of all equipment protection and safety control features (e.g., motor high temperature, seal fail, hardware interlocks, estops, etc.) and include configuration of the VFD (if applicable) prior to equipment startup.
2. Equipment Demonstration Testing shall generally be defined as the formal and scheduled demonstration of equipment/system operations in accordance with the requirements of the Contract Documents, including all required performance or acceptance testing. This formal demonstration shall be performed in the presence of the Engineer by representatives of the General Contractor, any Subcontractors directly responsible for the equipment provided, and the equipment Manufacturer.
3. Operator Training shall generally be defined as the formal and scheduled instruction of plant personnel and other Owner designated representatives in the proper operations of provided equipment, and in the techniques, methods, schedules, etc. associated with maintenance. This formal training shall be performed in the presence of the Engineer, by representatives of the Contractor, any subcontractors directly responsible for the equipment provided, and the

equipment Manufacturer. Operator Training shall also include remote assistance to plant personnel by Manufacturer representatives during the initial operations of the equipment.

C. Related Work Specified Elsewhere:

1. Process equipment/systems are specified in Division 11.
2. Instrumentation and control systems are specified in Division 13.
3. Plumbing and HVAC Systems are specified in Division 15.
4. Electrical systems are specified in Division 16.

D. Submittals:

1. In accordance with the requirements of Section 01340.
2. Contractor shall coordinate with subcontractors and Manufacturers and provide a proposed start-up, testing and training plan for each piece of equipment including detailed plans for temporary bypass pumping or temporary facilities, when required.
 - a. The startup, testing and training plan shall include a written outline description of the means and methods to be employed during the certified equipment test of each piece of equipment as well as the anticipated sequence and duration of activities.
 - b. The startup, testing and training plan shall include the name(s) and resume(s) of the duly authorized Manufacturer's Representatives proposed for the project. The qualifications of duly authorized representatives of the Manufacturer are identified in Paragraph 1.2 below.
 - c. The startup, testing and training plan shall include proof of calibration of decibel meter(s) and flow meter(s) to be used in Equipment Startup(s).
 - d. The startup, testing and training plan shall comply with the sequencing and scheduling requirements outlined in Section 01010.
 - e. The startup, testing and training plan shall identify the location and type of temporary flow meters to be utilized, where required herein.
 - f. Equipment startup and testing shall not be scheduled for Fridays without prior agreement by the Owner and Engineer.
 - g. Contractor shall assume a maximum of 3 days per week of availability by the Engineer for equipment startup, training and demonstration testing. Availability beyond this will be considered on a case-by-case basis with prior agreement by the Owner and Engineer.
 - h. Contractor shall revise and resubmit the startup, testing and training plan to reflect the discussions and requirements from the Pre-Startup Meeting.
 - i. Contractor shall submit manufacturer Operations and Maintenance Manuals, along with updated control system drawings, at least 2 months prior to Equipment Startup.
3. Contractor shall submit updated system-specific startup, testing and training plans a minimum of 14 days prior to individual system starts, based on discussions at the Pre-Startup Meeting and subsequent coordination with Manufacturers, RPR and Owner (e.g., process availability, equipment status, valving, lockout/tagout, etc.). Refer to schedule and notification requirements below.

EQUIPMENT STARTUP, TESTING AND OPERATOR TRAINING

4. Following successful Equipment Startup, Operator Training and Equipment Demonstration Testing, submit:
 - a. Completed Equipment Startup Certification forms
 - b. Completed VFD Parameter Setup Checklist and VFD Parameter Setup Verification forms
 - c. Completed Operator Training forms
 - d. Completed Operating Training videos
 - e. Completed Equipment Demonstration Testing Certification forms
- E. Schedules and Notifications:
 1. Contractor shall provide Engineer with at least a 10 calendar day notice prior to initiating startup activities to allow necessary coordination with Engineer and Owner representatives. If startups are conducted in groups of activities, the notification shall be provided for each grouping. The actual date and time for testing and/or training will be the first mutually acceptable date and time available to all parties subsequent to receipt of the request.
 2. Contractor shall be responsible for any and all coordination necessary with the daily operations of the facility to accommodate the testing schedule.
 3. Operator Training shall follow successful Equipment Startup and must be completed prior to the equipment being put on-line for uninterrupted service. Contractor may formally request that Operator Training be conducted concurrently with the Equipment Demonstration Testing; however, this determination will be made on a case-by-case basis by the Engineer and Owner. Under no circumstances will conditions of the testing interfere with the ability of Owner's representatives to observe necessary features, to hear and understand instructions, or to ask questions. If such conditions occur, then Operator Training will not be allowed to run concurrently with Equipment Demonstration Testing.
 4. Contractor shall maintain a shared calendar for the Owner, Engineer and Contractor to document the agreed upon dates for individual Equipment Startup, Operator Training, and Equipment Demonstration Testing.

1.2 QUALITY ASSURANCE

- A. Duly authorized Manufacturer's Representatives shall meet the following criteria:
 1. A direct employee of the Manufacturer
 2. Fluent in the English language
 3. Has a minimum of 5 years of experience in the proper installation, adjustment, operation, testing, and startup of the specified model, including, but not limited to, equipment calibration, and other mechanical or electrical components of the equipment.
 4. Sales personnel, marketing personnel or local representatives will not be accepted as a duly authorized representative of the Manufacturer unless the Manufacturer has certified them accordingly.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 EQUIPMENT STARTUP

- A. Equipment startup shall be performed by the authorized representative(s) of the Manufacturer as identified in the Submittals.
- B. The Equipment Startup shall be performed prior to Operator Training and prior to Equipment Demonstration Testing.
- C. No form of energy shall be applied to any part of the system prior to receipt by the Engineer of a certified statement of approval of the installation from the Contractor. This certification shall contain a statement by an authorized representative of the equipment Manufacturer that the equipment is ready for testing, as outlined below.
- D. As part of the Equipment Startup, the Contractor and Manufacturer shall:
 - 1. Verify that the equipment is installed properly and in accordance with Manufacturer's requirements and instructions, and as such, it is appropriate to apply power to the units in question.
 - 2. Verify that all manual and all automatic equipment protection and safety control features of the equipment function properly, including all alarms, and all activation and deactivation sequences.
 - 3. Verify that equipment can receive remote control signals and send remote feedback signals.
 - 4. Verify that the equipment can operate without excessive noise, vibration, overheating, overloading, jamming, etc. during specified conditions.
 - 5. Verify and document equipment capacity and amperage draws (on all power feeds) with equipment running under specified conditions.
 - 6. Verify and document the noise level of equipment, drives and motors, unless otherwise noted, shall not exceed 90 dBA, as measured 3 feet from the unit under free field conditions.
 - a. Each unit shall be monitored for compliance running under specified conditions with other area equipment deactivated.
 - b. Contractor shall provide certified proof of calibration for instrument utilized to measure noise level.
- E. Each piece of equipment shall be tested sufficiently to ensure that all features required to be demonstrated and/or verified during the equipment certification testing are within acceptable limits. The startup shall not be considered complete until the unit is fully capable of passing the equipment certification testing.
- F. Where multiple units are provided, each unit shall undergo startup procedures.
- G. The duly authorized representative of the Manufacturer shall provide all specialty tools, specialty testing equipment and labor necessary for the start-up of the equipment.
- H. The Contractor shall provide all power, chemical, tools, equipment, labor, water and fuel as required for Equipment Startup.
 - 1. The Contractor shall be responsible for all contacts and arrangements as necessary with the proper municipal departments and/or public utility companies to arrange for temporary and/or separate billing so that bills associated with testing and startup procedures can be easily identified.
 - 2. Contacts and arrangements with the local power company shall include, but not be limited to, all arrangements as necessary so that peak power demands

incurred during testing and startup procedures will not become a part of the permanent record for determining future power demand charges for the Owner.

3. All waste materials shall be disposed of by the Contractor in an environmentally acceptable manner at no additional cost to the Owner.
- I. In the event of an unsuccessful equipment start-up, Manufacturer and Contractor shall make necessary alternations, adjustments, repairs and replacements and the equipment start-up shall be repeated.
- J. The Manufacturer Representative's shall fill out the Equipment Start-Up Certification form included at the end of this Section. Startup will not be considered complete until this form has been provided to the Engineer along with the Manufacturer Representative's field report.

3.2 EQUIPMENT DEMONSTRATION TESTING

- A. Equipment Demonstration Testing shall be performed after the Equipment Startup is completed and it has been verified that equipment functions in accordance with the requirements of the Contract Documents in all aspects. Equipment Demonstration Testing shall be performed by the authorized representative(s) of the Manufacturer.
- B. Equipment Demonstration Testing shall not be scheduled concurrently with Equipment Startup without the prior approval of the Engineer.
- C. If the Engineer has arrived on-site for the scheduled Equipment Demonstration Testing and the equipment is not capable of demonstrating complete compliance with the Contract Documents, or if the Manufacturer's representative is not present, the Contractor shall be responsible for all costs to the Engineer associated with failed testing, including travel expenses. The importance of prior and proper equipment demonstrations to verify that the requirements of the Equipment Demonstration Testing will be met is stressed.
- D. At a minimum during the Equipment Demonstration Testing, the Contractor shall complete the following to the satisfaction of the Engineer:
 1. Demonstrate that the equipment is installed properly and in accordance with Manufacturer's requirements and instructions, and as such, it is appropriate to apply power to the units in question.
 2. Demonstrate all manual and all automatic equipment protection and safety control features of the equipment functions properly, including all alarm, activation and deactivation sequences.
 3. Demonstrate that the equipment can operate without excessive noise, vibration, overheating, overloading, jamming, etc. during normal operating conditions.
 4. Demonstrate the full specified range of equipment operation when controlled remotely by the controls system.
 5. Other specific requirements as outlined within the individual specifications sections.
- E. Each piece of equipment shall be tested sufficiently to ensure that all features required to be demonstrated and/or verified are within acceptable limits.
- F. Where multiple units are provided, each unit shall undergo equipment certification testing procedures individually and then with multiple units on-line to verify the total systems output capacity and performance.
- G. The duly authorized representative of the Manufacturer shall provide all specialty tools, specialty testing equipment and labor necessary for the start-up and testing of

the equipment.

- H. The Contractor shall provide all power, chemical, equipment, labor, water and fuel as required for startup and testing.
- I. All equipment provided on the project shall be demonstrated to function properly. Demonstration as a component of an overall system shall not relieve the Contractor of their responsibilities to demonstrate proper operation or verify specific requirements for each individual component.
- J. Minimum Testing Requirements for Pumps:
 - 1. If sufficient sewage or water is not available for tests, Contractor will provide water at their expense for testing, if so directed.
 - 2. During tests, Manufacturer shall observe and record head, output, rpm, motor input and amperage. Sufficient test points shall be obtained to develop accurate pump system curve. If multiple operational points are specified, compliance with all points must be sufficiently demonstrated.
 - 3. Fully demonstrate ability to operate at specified conditions without motor overload.
 - 4. For mechanical seals, after a run-in period of 30 minutes, the seal area shall be wiped dry. The pump shall be operated for a 10-minute period. No measurable leakage shall be detected from the mechanical seal.
 - 5. Refer to Section 11000, 11310 and 15400, as applicable, for additional details.
- K. Minimum Testing Requirements for Instrumentation/Control Systems:
 - 1. All instruments shall be calibrated in the presence of the Engineer.
 - 2. All transmitters or direct-operated receivers shall be calibrated to impose input values representing zero percent, ten percent, and eighty percent of full scale.
 - 3. The inputs and outputs of devices, as appropriate, shall be connected to manometers for differential pressure devices, or compared to measured levels, rates or quantities, during calibration. The receiving devices shall be adjusted to read the calibrated output of the initial calibration.
 - 4. After placing each measuring system in service, an actual comparison of the measured variable versus readout shall be made. For each differential pressure based measuring system, a manometer shall be connected to the connections provided in the piping, tank, or other appropriate device. Each system shall meet the manufacturer's standard accuracy.
 - 5. Secondary functions, such as sequencing, timing features, alarm actuation and pacing shall be adjusted during initial calibration, demonstrated after the system is placed in service and adjusted during equipment demonstration testing, as necessary.
 - 6. Linkage or range adjustments shall be sealed by colored lacquer in the presence of the Engineer immediately following calibration.
 - 7. Process calibration, such as volumetric drawdown tests on flows and level measurements, shall be conducted on all measuring systems as requested by the Engineer. Once established as being within acceptable accuracy limits, future tests which require use of the measuring device to demonstrate system operations can utilize generation of mA signals to simulate level, flow or similar variable variations.
 - 8. Refer to Division 13 and Section 15604 for additional details.

- L. Minimum Testing Requirements for Electrical Systems.
 - 1. Refer to Division 16.
- M. In the event of unsuccessful Equipment Demonstration Testing, Manufacturer and Contractor shall make necessary alternations, adjustments, repairs and replacements and the equipment testing shall be repeated.
- N. The Manufacturer Representative's shall fill out the Equipment Demonstration Testing Certification form included at the end of this Section. Equipment Demonstration Testing will not be considered complete until this form has been provided to the Engineer along with the Manufacturer representative field report.

3.3 OPERATOR TRAINING

- A. Operator Training shall be performed by the authorized representative(s) of the Manufacturer as identified in the Submittals.
- B. Unless otherwise noted within the specific specification sections, provide minimum of one day (8-hour days, not including travel time) of combined training and operational assistance for plant operators for each piece of equipment in the proper operations of provided equipment, and in the techniques, methods, schedules, etc. associated with maintenance.
- C. The level of the training and operational assistance provided shall be as required to ensure proper understanding of the equipment's operations, maintenance and warranty conditions. Should manufacturer require time in addition to the minimums indicated herein, or within the individual specification sections, to sufficiently detail the proper operations and maintenance of the equipment, it will be provided at no additional cost to Owner. Under absolutely no circumstances shall warranties become void due to Owner's failure to follow operational and maintenance procedures which were not fully detailed and described to Owner's representatives during these sessions.
- D. Refer to individual equipment specification sections for further requirements.
- E. The manufacturer representative shall fill out the Operator Training Certification form included within this Section. Training will not be considered complete until this form has been provided to the Engineer.

EQUIPMENT START-UP CERTIFICATION

Owner: _____ Date: _____

Project _____

Contractor: _____

Equipment Manufacturer: _____

Equipment: _____

Specification Number: _____

As an authorized representative of the equipment manufacturer, the undersigned certifies that the equipment listed above conforms to the requirements of the Contract Documents. The undersigned authorized representative of the manufacturer further certifies that the equipment has been installed in accordance with the manufacturer's written instructions, that it is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

(Manufacturer's Authorized Representative/ Signature & Printed Name) (Date)

(Contractor/ Signature & Printed Name) (Date)

(Witnessed by Engineer/ Signature & Printed Name) (Date)

** Manufacturer's Representative to provide a copy of Field Report via separate transmittal **

OPERATOR TRAINING CERTIFICATION

Owner: _____ Date: _____

Project _____

Contractor: _____

Equipment Manufacturer: _____

Equipment: _____

Specification Number: _____

I, the undersigned Manufacturer's Authorized Representative, have trained the Owner's personnel listed below in the proper operation and maintenance of the above listed equipment.

(Manufacturer's Authorized Representative/ Signature & Printed Name)	(Date)
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(Owner's Representative/ Signature & Printed Name)	(Date)
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(Witnessed by Engineer/ Signature & Printed Name)	(Date)
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EQUIPMENT DEMONSTRATION TESTING CERTIFICATION FORM

Owner: _____ Date: _____

Project _____

Contractor: _____

Equipment Manufacturer: _____

Equipment: _____

Specification Number: _____

This certifies that the entire equipment/system has met the requirements of Section 01800, 16950 and all other applicable requirements of the contract documents.

(Manufacturer's Authorized Representative/ Signature & Printed Name) (Date)_____
(Contractor/ Signature & Printed Name) (Date)_____
(Witnessed by Engineer/ Signature & Printed Name) (Date)

** Manufacturer's Representative to provide a copy of Field Report via separate transmittal **

END OF SECTION

SECTION 02050ADEMOLITIONPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. The Contractor shall furnish all labor, materials, tools, equipment and apparatus necessary and shall do all work required to complete the demolition, removal, and alterations of existing facilities as indicated on the Drawings, as herein specified, and/or as directed by the Engineer.
2. Demolition and alteration work within occupied areas shall be accomplished with minimum interference to the occupants and to the plant which shall be in continuous operation during construction.
3. All equipment, piping, and other materials that are not to be relocated or to be returned to the Owner shall become the property of the Contractor and shall be disposed of by him, away from the site of the work and at his own expense.
4. All demolition or removal of existing structures, utilities, equipment, and appurtenances shall be accomplished without damaging the integrity of existing structures, equipment, and appurtenances to remain, to be salvaged for relocation or stored for future use.
5. Such items that are damaged shall be either repaired or replaced at the Contractor's expense to a condition at least equal to that which existed prior to the start of his work.
6. Unless otherwise indicated, all items labeled to be "removed", "demolished" or "remove/demolish" shall be removed and disposed of off site in accordance with all Local, State and Federal Regulations.
7. The Contractor shall not collect any samples of either Building Materials, Wastes, Soils, or any other site/project related materials, nor have the samples analyzed for any reason without prior written approval from the Owner or Engineer. Furthermore, the Contractor shall not hire or contract with another party or Consultant to conduct sampling of either Building Materials, Wastes, Soils, or any other site/project related materials or to conduct analytical analysis.
 - a. All sampling requests are to be directed in written format to the Owner and Engineer.
 - b. By collecting unauthorized samples, the Contractor shall assume any and all financial burden of the required corrective action.
 - c. If a sample is collected and analyzed without prior written approval from the Owner or Engineer, the Contractor shall be responsible for any and all remediation required by any applicable regulatory authority arising from or related to the samples collected and analyzed, as the validity of the materials sampled, sample locations and sampling protocols utilized cannot be confirmed by the Owner's or Engineer's independent Consultant.

- B. Related Work Specified Elsewhere: (When Applicable)
 - 1. Earthwork is specified in Section 02200.
 - 2. See Summary of Work, Section 01010.

1.2 JOB CONDITIONS

- A. Condition of Structures:
 - 1. The Owner assumes no responsibility for the actual condition of structures to be demolished.
 - 2. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner as far as practicable. However, variations within the structures may occur due to Owner's removal and salvage operations prior to the start of demolition work (where applicable).

1.3 UTILITIES

- A. Utility Locations:
 - 1. Utility locations shown on the plans are approximate only, based on information supplied by the utility companies.
- B. Coordination with Utilities:
 - 1. The Contractor shall make all necessary arrangements and perform any necessary work to the satisfaction of affected utility companies and governmental divisions involved with the discontinuance or interruption of affected public utilities and services.

1.4 SUBMITTALS

- A. Schedule - Demolition:
 - 1. Submit two (2) copies of proposed methods and operations of demolition to the Engineer for review prior to the start of work. Include in the schedule the coordination for shut-off, capping and continuation of utility services as required.
 - 2. Provide a detailed sequence of demolition and removal work to ensure the uninterrupted progress of the Owner's operations.

1.5 PROTECTIONS

- A. Ensure the safe passage of persons around the area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities and persons. Erect temporary, covered passageways as required by authorities having jurisdiction.
- B. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structures to be demolished and adjacent facilities to remain.

1.6 DAMAGES

- A. The Contractor shall promptly repair damages caused by demolition operations to adjacent facilities at no cost to the Owner.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - PERFORMANCE

- A. Remove and dispose of non-salvageable material in accordance with all applicable local and state laws, ordinances and code requirements.
- B. Dispose of material daily as it accumulates.
- C. Carefully remove, store and protect from damage all materials to be salvaged.
- D. Buildings and Adjacent Property:
 - 1. Protect all buildings and property adjacent to equipment to be removed from damage by erecting suitable barriers or by other suitable means.
 - 2. Leave such buildings in a permanently safe and satisfactory condition.
- E. Maintaining Traffic:
 - 1. Ensure minimum interference with roads, streets, driveways, sidewalks and adjacent facilities.
 - 2. Do not close or obstruct streets, sidewalks, alleys or passageways without permission from authorities having jurisdiction.
- F. Architectural, structural, mechanical, process and electrical demolition, removal and alteration are indicated in the corresponding sections.
- G. Mechanical/Process Demolition:
 - 1. Mechanical/Process demolition in general shall consist of the dismantling and removal of existing piping, tanks, pumps, motors, equipment and other appurtenances as specified, and indicated on the Drawings.
 - 2. It shall also include, where necessary, the cutting of existing piping for the purpose of making connections thereto.
 - 3. Piping not indicated to be removed but which may interfere with construction shall be removed to the nearest solid support, capped and left in place. Where piping that is to be removed passes through the wall of existing structures, it shall be cut off and properly capped on each side of the wall.
 - 4. When piping is to be altered or removed underground, the remaining piping shall be properly capped or plugged.
 - 5. Abandoned underground piping shall be left in place unless it interferes with new structures or unless otherwise noted on the Drawings.
- H. Salvage:
 - 1. Salvaged items shall be stored on site for the Owner in an acceptable location and manner.
- I. Wetwell Cleaning: (unless indicated otherwise on the Drawings):
 - 1. Contractor shall give Owner 14 days minimum notice prior to beginning work in structures requiring draining and cleaning; which are to be renovated or cleaned as part of this project.
 - 2. When the existing wetwells are empty of liquid, any solids and/or debris remaining that are not easily drained, Contractor shall remove and dispose of all grit, sludge, rags, solids and/or debris within the wetwell. The Contractor shall then clean the wetwell walls, floor and ceiling using a high-pressure steam cleaning device.

- J. Maintain Treatment:
 - 1. During demolition, maintain treatment as outlined in Section 01010, Summary of Work.
- K. Demolition Sequence:
 - 1. The demolition sequence is to conform the reviewed and approved project schedule, and restrictions outlined in Section 01310, Construction Schedules.
- L. Pest Control:
 - 1. Provide pest control when needed or when directed by the Engineer.
 - 2. Exterminate and prevent migration of rodents to adjoining buildings in accordance with the requirements of the state or local health department.

END OF SECTION

SECTION 02200EARTHWORKPART 1 - GENERAL1.1 DESCRIPTION

- A. The Work described by this Section consists of all earthwork encountered and necessary for construction of the project as indicated in the Contract Documents, and includes but is not limited to the following:
 - 1. Excavation
 - 2. Backfilling and Filling
 - 3. Compaction
 - 4. Embankment Construction
 - 5. Grading
 - 6. Providing soil material as necessary
 - 7. Disposal of excess suitable material and unsuitable materials
- B. Related Work Specified Elsewhere: (When Applicable)
 - 1. Traffic Regulation is specified in Division 1.
 - 2. Clearing and Grubbing, Dewatering, Filter Fabric, Temporary Erosion Control, Stripping and Stockpiling of Topsoil, Sheeting, Landscaping, and Paving are specified in the appropriate sections of this Division.
 - 3. Section 01400 - Quality Control.
 - 4. Pipe, fittings and valves are specified in Division 15 or 2.

1.2 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. All work shall be performed and completed in accordance with all local, state and federal regulations.
 - 2. The General Contractor shall secure all other necessary permits unless otherwise indicated from, and furnish proof of acceptance by, the municipal and state departments having jurisdiction and shall pay for all such permits, except as specifically stated elsewhere in the Contract Documents.
- B. Line and Grade:
 - 1. The Contractor shall establish the lines and grades in conformity with the Drawings and maintain same to properly perform the work.
- C. Testing Methods:
 - 1. Gradation Analysis: Where a gradation is specified the testing shall be in accordance with ASTM C-117-90 and ASTM C-136-93 (or latest revision).
 - 2. Compaction Control:
 - a) Unless otherwise indicated, wherever a percentage of compaction for backfill is indicated or specified, it shall be the in-place density divided by the maximum density and multiplied by 100. The maximum density shall be the density at optimum moisture as determined by ASTM Standard Methods of Test for Moisture-Density Relations of Soil Using

- 10-lb. Hammer and 18-in. Drop, Designation D-1557-91 (Modified Proctor), or latest revision, unless otherwise indicated.
- b) The in-place density shall be determined in accordance with ASTM Standard Method of Test for Density of Soil in Place by the Sand Cone method, Designation D 1556-90, (or latest revision) or Nuclear method Designation D2922.
 - c) Wherever specifically indicated, maximum density at optimum moisture may be determined by ASTM Standard Methods of Test for Moisture Density Relations of Soils, ASTM D-698-91 (Standard Proctor).
 - d) An Independent Testing Laboratory will be retained by the Owner to conduct all laboratory and field soil sampling and testing, and to observe earth work and foundation construction activities. Laboratory testing will consist of sieve analyses, natural water content determinations, and compaction tests. Field testing will consist of in-place field density tests and determination of water contents.

1.3 SUBMITTALS

- A. Collection of samples and testing of all materials for submittals shall be performed by the Independent Testing Laboratory and paid for by the Contractor until the materials are approved by the Owner or Engineer.
- B. Submit test results in accordance with the procedure specified in the General and Supplementary Conditions.
- C. Submit test results (including gradation analysis) and source location for all borrow material to be used at least 10 working days prior to its use on the site. Contractor shall identify and provide access to borrow sites.
- D. Submit moisture density curve for each type of soil (on site or borrow material) to be used for embankment construction or fill beneath structures or pavement.

1.4 TESTS

The Independent Testing Laboratory shall conform to the following procedures and standards:

- A. Submit test results in accordance with the procedure specified in the General and Supplementary Conditions.
- B. All testing shall be performed by a qualified Independent Testing Laboratory acceptable to the Engineer and Contractor at the Owner's expense unless otherwise indicated (see Section 01400 - Quality Control).
- C. Field density tests on embankment materials shall be as follows:
 - 1. Tests shall be taken on every 200 cubic yards of embankment material.
- D. Paved Areas and Building Slab Subgrade: Make at least one field density test of subgrade for every 2,000 sq. ft. of paved area or building slab, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 2,000 sq. ft. of overlaying building slab or paved area, but in no case less than 3 tests.
- E. Trenches: Field density test in trenches shall be taken at 75 linear foot intervals on every third lift.
- F. Foundation Wall Backfill: Take at least one (1) field density tests per lift per wall at locations and elevations as designated by the Engineer.

- G. In addition to the above tests the Independent Testing Laboratory will perform additional density tests at locations and times requested by the Engineer.
- H. Additional density testing will be required by the Engineer if the Engineer is not satisfied with the apparent results of the Contractor's compaction operation.
 - 1. If the test results fail to meet the requirements of these specifications, the Contractor shall undertake whatever action is necessary, at no additional cost to the Owner, to obtain the required compaction. The cost of retesting will be paid by Owner. The cost of retesting will be determined by Engineer and Owner will invoice Contractor for this cost. If unpaid after 60 days, the invoice amount for retesting will be deducted from the Contract Price. No allowance will be considered for delays in the performance of the work.
 - 2. If the test results pass and meet the requirements of these Specifications, the cost of the testing service will be borne by the Owner, but no allowance will be considered for delays in the performance of the work.

1.5 JOB CONDITIONS

- A. Site Information:
 - 1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner and Engineer will not be responsible for interpretations or conclusions drawn therefrom by the Contractor. Data are made available for the convenience of Contractor.
 - 2. Additional test borings and other exploratory operations may be made by Contractor at no additional cost to Owner.
- B. Existing Utilities and Structures:
 - 1. The locations of utilities and structures shown on the Drawings are approximate as determined from physical evidence on or above the surface of the ground and from information supplied by the utilities. The Engineer in no way warrants that these locations are correct. It shall be the responsibility of the Contractor to determine the actual locations of any utilities or structures within the project area.

PART 2 - PRODUCTS

2.1 SOIL MATERIAL

All materials are to conform to the appropriate section of the State of Connecticut Department of Transportation Standard Specification for Roads, Bridges and Incidental Construction Form 816 as amended (CT DOT Form 816).

- A. Crushed and/or Broken Stone, Crushed and Uncrushed Gravel: Shall conform to the requirements of Section M.01.01 of the CT DOT Form 816.
- B. Borrow: Shall conform to the requirements of Section 2.07 of the CT DOT Form 816.
- C. Free-Draining Material: Shall conform to the requirements of Section 2.08 of the CT DOT Form 816.
- D. Subgrade: Shall conform to the requirements of Section 2.09 of the CT DOT Form 816.

- E. Subbase: Shall conform to the requirements of Section 2.12 of the CT DOT Form 816.
- F. Granular Fill: Shall conform to the requirements of Section 2.13 of the CT DOT Form 816.
- G. Compacted Granular Fill: Shall conform to the requirements of Section 2.14 of the CT DOT Form 816.
- H. Pervious Structure Backfill: Shall conform to the requirements of Section 2.16 of the CT DOT Form 816.
- I. Rolled Granular Base: Shall conform to the requirements of Section 3.02 of the CT DOT Form 816.
- J. Concrete Base: Shall conform to the requirements of Section 3.03 of the CT DOT Form 816.
- K. Processed Aggregate Base: Shall conform to the requirements of Section 3.04 of the CT DOT Form 816.
- L. Processed Aggregate: Shall conform to the requirements of Section 3.05 of the CT DOT Form 816.
- M. Select Fill (Structural Fill): Shall consist of well graded granular material free of organic material, loam, wood, trash, snow, ice, frozen soil and other objectionable material and having no rocks with a maximum dimension of over 4 inches and meeting the following gradation requirements, except where it is used for pipe bedding in which case the maximum size shall be 2 inches.

<u>Sieve Designation</u>	<u>Percent by Weight Passing Square Mesh Sieve</u>
4 inch	100
3 inch	90-100
¼ inch	25-90
No. 40	0-30
No. 200	0-5

- N. Sand: Shall be well graded durable material free of organic matter and conform to the following gradation requirements:

<u>Sieve Designation</u>	<u>Percent by Weight Passing Square Mesh Sieve</u>
3/8 inch	100
No. 4	95-100
No. 16	50-85
No. 50	10-30
No.100	2-10
No.200	0-5

Sand conforming to the requirement for fine aggregate in ASTM Standard Specifications for Concrete Aggregate, Designation C-33, will meet the above requirement.

2.2 CONCRETE

- A. If concrete is required for excess excavation, provide 3,000 psi concrete complying with requirements of Section 03300.

2.3 FILTER FABRIC

- A. If filter fabric is required, refer to Section 02260.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the areas and conditions under which excavating, backfilling, filling, compaction and grading are to be performed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 EXCAVATION

A. General:

1. Excavation consists of removal and disposal of all material encountered when establishing line and grade elevations required for execution of the work.
2. The Contractor shall make excavations in such manner and to such widths as will give suitable room for building the structures or laying and jointing the piping; shall furnish and place all sheeting, bracing, and supports; shall do all cofferdamming, pumping, and draining; and shall render the bottom of the excavations firm, dry and acceptable in all respects.
3. All excavation shall be classified as either earth or ledge.
 - a) Earth Excavation shall consist of the removal, hauling and disposal of all earth materials encountered during excavation including but not limited to native soil or fill, pavement (bituminous or concrete), existing sewers and manholes, ashes, loam, clay, swamp muck, debris, soft or disintegrated rock or hard pan which can be removed with a backhoe, or a combination of such materials, and boulders that do not meet the definition of "Ledge" below.
 - b) Ledge Excavation: Shall consist of the removal, hauling, and disposal of all ledge or rock encountered during excavation. "Ledge" and "rock" shall be defined as any natural compound, natural mixture that in the opinion of the Engineer can be removed from its existing position and state only by drilling and blasting, wedging, sledging, boring or breaking up with power operated tools. No boulder, ledge, slab, or other single piece of excavated material less than two cubic yards in total volume shall be considered to be rock unless, in the opinion of the Engineer it must be removed from its existing position by one of the methods mentioned above.
4. The Contractor shall not have any right of property in any materials taken from any excavation. Do not remove any such materials from the construction site without the approval of the Engineer. This provision shall in no way relieve the Contractor of his obligations to remove and dispose of any

material determined by the Engineer to be unsuitable for backfilling. The Contractor shall dispose of unsuitable and excess material in accordance with the applicable sections of the Contract Documents.

- B. Additional Excavation: When excavation has reached required subgrade elevations, notify the Engineer and Resident Project Representative who will observe the conditions.
 - 1. If material unsuitable for the structure or paved area or pipeline (in the opinion of the Engineer) is found at or below the grade to which excavation would normally be carried in accordance with the Drawings and/or Specifications, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted select fill, screened stone, crushed stone, or concrete as directed by the Engineer.
 - 2. All excavated materials designated by the Engineer as unsuitable shall become the property of the Contractor and disposed of at locations in accordance with all State and local laws and the provisions of the Contract Documents.
- C. Unauthorized Excavation: Shall consist of removal of materials beyond indicated subgrade elevations or dimensions without specific authorization of Engineer. Unauthorized excavation, as well as remedial work required by the Engineer shall be at the Contractor's expense. Remedial work required is as follows:
 - 1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation with select fill or screened stone compacted to 95%. Provide 12" minimum select fill or screened stone directly under footings. Concrete fill may be used to bring elevations to proper position, when acceptable to Engineer.
 - 2. If the bottom of a trench is excavated beyond the limits indicated, backfill the resulting void with thoroughly compacted screened stone, unless otherwise indicated.
 - 3. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Engineer.
- D. Structural Excavation:
 - 1. Shall consist of the removal, hauling, disposal, of all material encountered in the excavation to permit proper installation of structures.
 - 2. Excavations for structures shall be carried to the lines and subgrades shown on the Drawings.
 - 3. Excavate areas large enough to provide suitable room for building the structures.
 - 4. The extent of open excavation shall be controlled by prevailing conditions subject to any limits designated by the Engineer.
 - 5. Provide, install, and maintain sheeting and bracing as necessary to support the sides of the excavation and to prevent any movement of earth which could diminish the width of the excavation or otherwise injure the work, adjacent structures, or persons and property in accordance with all state and OSHA safety standards.
 - 6. Erect suitable fences around structure excavation and other dangerous locations created by the work, at no additional cost to the Owner.

7. Exposed subgrade surfaces shall remain undisturbed, protected, and maintained as uniform, plane areas and shape to receive the foundation components of the structure.
 - a. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
 - b. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade and trim bottoms to required lines and grades to leave solid base to receive the structure.
 - c. If a structure is to be constructed within the embankment, the fill shall first be brought to a minimum of 3 feet above the base of the footing. A suitable excavation shall then be made as though the fill were undisturbed earth.
- E. Trench Excavation: Shall consist of removal, hauling and disposal of all material encountered in the excavation to the widths and depths shown on the Drawings to permit proper installation of underground utilities.
 1. Excavate trenches to the uniform width shown on the Drawings sufficiently wide to provide sufficient space for installation, backfilling, and compaction. Every effort should be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed and consolidated.
 2. Trenches shall be excavated with approximately vertical sides between the elevation of the center of the pipe and an elevation one foot above the top of the pipe.
 3. Grade bottoms of trenches as indicated for pipe and bedding to establish the indicated slopes and invert elevations, notching under pipe joints to provide solid bearing for the entire body of the pipe, where applicable.
 4. If pipe is to be laid in embankments or other recently filled material, the material shall first be placed to the top of the fill or to a height of at least two feet above the top of the pipe, whichever is the lesser. Particular care shall be taken to ensure maximum consolidation of material under the pipe location. The pipe trench shall be excavated as though in undisturbed material.
 5. Unless otherwise specifically directed or permitted by the Engineer, begin excavation at the low end of sewer and storm lines and proceed upgrade.
 6. Perform excavation for force mains and water mains in a logical sequence.
 7. The extent of open excavation shall be controlled by prevailing conditions subject to any limits prescribed by the Engineer.
 8. As the excavation progresses, install such shoring and bracing necessary to prevent caving and sliding and to meet the requirements of the state and OSHA safety standards, as outlined in the appropriate section of this Specification.
- F. Protection of Persons, Property and Utilities:
 1. Barricade open excavations occurring as part of this work and post with warning lights in compliance with local and State regulations.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and

other hazards created by earthwork operations. Exercise extreme caution and utilize sheeting, bracing, and whatever other precautionary measures that may be required.

3. Rules and regulations governing the respective utilities shall be observed in execution of all work. Active utilities and structures shall be adequately protected from damage, and removed or relocated only as indicated or specified. Inactive and abandoned utilities encountered in excavation and grading operations shall be removed, plugged or capped only with written authorization of the utility owner. Report in writing to the Engineer, the locations of such abandoned utilities. Extreme care shall be taken when performing work in the vicinity of existing utility lines, utilizing hand excavation in such areas, as far as practicable.
 4. Repair, or have repaired, all damage to existing utilities, structures, lawns, other public and private property which results from construction operations, at no additional expense to the Owner, to the complete satisfaction of the Engineer, the utility, the property owner, and the Owner.
- G. Use of Explosives:
1. Do not bring explosives onto site or use in work without prior written permission from authorities having jurisdiction. Contractor is solely responsible for handling, storage, and use of explosive materials when their use is permitted.
 2. All blasting shall be performed in accordance with all pertinent provisions of the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc.
- H. Stability of Excavations:
1. Slope sides of excavations to comply with all codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
 2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- I. Shoring and Bracing:
1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
 2. Provide trench shoring and bracing to comply with local codes and authorities having jurisdiction. Refer to Specification Section 02156.
 3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Install shoring and bracing as excavation progresses.
- J. Material Storage:
1. Stockpile excavated materials which are satisfactory for use on the work until required for backfill or fill. Place, grade and shape stockpiles for proper drainage and protect with temporary seeding or other acceptable methods to control erosion.
 2. Locate and retain soil materials away from edge of excavations.
 3. Dispose of excess soil material and waste materials as herein specified.
- K. Dewatering:

1. To ensure proper conditions at all times during construction, the Contractor shall provide and maintain ample means and devices (including spare units kept ready for immediate use in case of breakdowns) with which to intercept and/or remove promptly and dispose properly of all water entering trenches and other excavations (including surface and subsurface waters).
 2. Excavations shall be kept dry until the structures, pipes, and appurtenances to be built therein have been completed to such extent that they will not be floated or otherwise damaged. Refer to Specification Section 02401.
- L. Cold Weather Protection:
1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.
 2. No frozen material shall be used as backfill or fill and no backfill shall be placed on frozen material.
- M. Separation of Surface Material:
1. The Contractor shall remove only as much of any existing pavement as is necessary for the prosecution of the work.
 2. Prior to excavation, existing pavement shall be cut where in the opinion of the Engineer it is necessary to prevent damage to the remaining road surface.
 3. Where pavement is removed in large pieces, it shall be disposed of before proceeding with the excavation.
 4. From areas within which excavations are to be made, loam and topsoil shall be carefully removed and separately stored to be used again as directed; or, if the Contractor prefers not to separate surface materials, he shall furnish, as directed, loam and topsoil at least equal in quantity and quality to that excavated.
- N. Dust Control:
1. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of streets as necessary, so as to minimize the creation and dispersion of dust. Refer to Specification Section 01562.
 2. If the Engineer decides that it is necessary to use calcium chloride for more effective dust control, the contractor shall furnish and spread the material, as directed.

3.3 BACKFILL AND FILL

A. General:

1. Backfilling shall consist of replacing material removed to permit installation of structures or utilities, as indicated in the Contract Documents.
2. Filling shall consist of placing material in areas to bring them up to grades indicated on the Drawings.
3. The Contractor shall provide and place all necessary backfill and fill material, in layers to the required grade elevations.
4. Backfill excavations as promptly as work permits, but not until completion of the following:
 - a. Acceptance by Engineer of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.

- b. Inspection, approval, and recording locations of underground utilities.
 - c. Removal of concrete formwork.
 - d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Temporary sheet piling driven below bottom of structures shall be removed in manner to prevent settlement of the structure or utilities, or cut off and left in place if required.
 - e. Removal of trash and debris.
 - f. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
 - g. Density testing having results meeting requirements specified herein.
- 5. In general, and unless otherwise indicated, material used for backfill of trenches and excavations around structures shall be suitable excavated material which was removed in the course of making the construction excavation. Unless otherwise specified or allowed by the Engineer the backfill and fill shall be placed in layers not to exceed 8 inches in thickness.
 - 6. All fill and backfill under structures and pavement, and adjacent to structures, shall be compacted crushed stone or select fill as specified or as indicated on the Drawings. The fill and backfill materials shall be placed in layers not exceeding 8 inches in thickness.
 - 7. All structures (including manholes) shall be placed on a 6-inch mat of screened stone unless otherwise indicated.
 - 8. Suitable excavated material shall meet the following requirements:
 - a. Free from large clods, silt lumps or balls of clay.
 - b. Free from stones and rock fragments with larger than 12 inch max. dimension.
 - c. Free from organics, peat, etc.
 - d. Free from frozen material.
 - 9. If sufficient suitable excavated material is not available from the excavations, and where indicated on the Drawings, the backfill material shall be select fill or common borrow, unless otherwise indicated, as required and as directed by the Engineer.
 - 10. Do not backfill with, or on, frozen materials.
 - 11. Remove, or otherwise treat as necessary, previously placed material that has frozen prior to placing backfill.
 - 12. Do not mechanically or hand compact material that is, in the opinion of the Engineer, too wet.
 - 13. Do not continue backfilling until the previously placed and new materials have dried sufficiently to permit proper compaction.
 - 14. The nature of the backfill materials will govern the methods best suited for their placement and compaction. Compaction methods and required percent compaction is covered in Compaction section.
 - 15. Before compaction, moisten or aerate each layer as necessary to provide a water content necessary to meet the required percentage of maximum dry density for each area classification specified.
 - 16. Do not allow large masses of backfill material to be dropped into the excavation in such a manner that may damage pipes and structures.

17. Place material in a manner that will prevent stones and lumps from becoming nested.
 18. Completely fill all voids between stones with fine material.
 19. Do not place backfill on or against new concrete until it has attained sufficient strength to support loads without distortion, cracking, and other damage.
 20. Deposit backfill and fill material evenly on all sides of structures to avoid unequal soil pressures.
 21. Keep stones or rock fragments with a dimension greater than two inches at least one foot away from the pipe or structure during backfilling.
 22. Leave sheeting in place when damage is likely to result from its withdrawal.
 23. Completely fill voids left by the removal of sheeting with screened stone which is compacted thoroughly.
- B. Pipe Bedding, Initial Backfill and Trench Backfill
1. Place bedding and backfill in layers of uniform thickness specified herein, and as shown on the Drawings.
 2. Thoroughly compact each layer by means of a suitable vibrator or mechanical tamper.
 3. Install pipe bedding and initial backfill in layers of uniform thickness not greater than eight (8) inches.
 4. Deposit the remainder of the backfill in uniform layers not greater than eight inches.
 5. Provide underground utility marking tape for new utility trenches as shown on the Drawings. Refer to Section 02650 – Buried Utility Markings.
 6. Where soft silt and clay soils are encountered the trench shall be excavated six inches below the normal bedding and backfilled with 6-inches of compacted sand.
 7. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and which are carried below the bottom of such footings, or which pass under wall footings. Place concrete to the level of the bottom of adjacent footings.
 8. The following schedule lists the bedding materials for various types of pipe. Refer to the pipe trench detail for dimensional requirements.

BEDDING REQUIREMENTS

DI or Concrete Pipe screened stone or select fill.

PVC or PE Pipe screened stone.

9. The following schedule lists the initial backfill requirements for various types of pipes. Refer to the pipe trench detail for dimensional requirements.

INITIAL BACKFILL REQUIREMENTS

DI or Concrete,
Pipe Screened stone or select fill

PVC or PE
Pipe Screened stone

10. Special bedding and backfill requirements shown on the Drawings supersede requirements of this section.
 11. Where pipes or structures pass through or under the impervious core of the lagoon embankments, bedding and backfill material shall consist of the impervious embankment material. Extra care should be given to properly and thoroughly compact the bedding material around the pipe.
- C. Improper Backfill:
1. When excavation and trenches have been improperly backfilled, and when settlement occurs, reopen the excavation to the depth required, as directed by the Engineer.
 2. Refill and compact the excavation or trench with suitable material and restore the surface to the required grade and condition.
 3. Excavation, backfilling, and compacting work performed to correct improper backfilling shall be performed at no additional cost to the Owner.
- D. Ground Surface Preparation:
1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, scarify or break-up sloped surface steeper than 1 vertical to 4 horizontal.
 2. When existing ground surface has a density less than that specified under "compaction" for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

3.4 COMPACTION

A. General:

1. Control soil compaction during construction to provide not less than the minimum percentage of density specified for each area classification.

B. Percentage of Maximum Density Requirements:

1. Compact soil to not less than the following percentages of maximum dry density determined in accordance with ASTM D1557 as indicated.

- a. Structures: Compact each layer of backfill or fill material below or adjacent to structures to at least 95% of maximum dry density (ASTM D1557).
 - b. Off Traveled Way Areas: Compact each layer of backfill or fill material to at least 90% of maximum dry density (ASTM D1557).
 - c. Walkways: Compact each layer of backfill or fill material to at least 93% of maximum dry density (ASTM D1557).
 - d. Roadways, Drives and Paved Areas: Compact each layer of fill, subbase material, and base material to at least 95% of maximum dry density (ASTM D1557).
 - e. Pipes: Compact bedding material and each layer of backfill to at least 90% maximum dry density (ASTM D1557). Where backfilling with excavated material, compact to native field density.
 - f. Embankments: Compact each layer of embankment material to at least 95% of maximum dry density (ASTM D1557).
- C. Moisture Control:
1. Where subgrade or a layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, in quantities controlled to prevent free water appearing on surface during or subsequent to compaction operations.
 2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
 3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory level.
- D. Embankment Compaction:
1. After each embankment layer has been spread to the required maximum 8-inch thickness and its moisture content has been adjusted as necessary, it shall be rolled with a sufficient number of passes to obtain the required compaction. One pass is defined as the required number of successive trips which by means of sufficient overlap will insure complete coverage and uniform compaction of an entire lift. Additional passes shall not be made until the previous pass has been completed.
 2. When any section of an embankment sinks or weaves excessively under the roller or under hauling units and other equipment, it will be evident that the required degree of compaction is not being obtained and that a reduction in the moisture content is required. If at any place or time such sinking and weaving produces surface cracks which, in the judgment of the Engineer are of such character, amount, or extent to indicate an unfavorable condition, he will recommend operations on that part of the embankment to be suspended until such time as it shall have become sufficiently stabilized. The ideal condition of the embankment is that attained when the entire embankment below the surface being rolled is so firm and hard as to show only the slightest weaving and deflection as the roller passes.
 3. If the moisture content is insufficient to obtain the required compaction, the rolling shall not proceed except with the written approval of the Engineer, and

in that event, additional rolling shall be done to obtain the required compaction. If the moisture content is greater than the limit specified, the material of such water content may be removed and stockpiled for later use or the rolling shall be delayed until such time as the material has dried sufficiently so that the moisture content is within the specified limits. No adjustment in price will be made on account of any operation of the Contractor in removing and stockpiling, or in drying the materials or on account of delays occasioned thereby.

4. If because of insufficient overlap, too much or too little water, or other cause attributable to defective work, the compaction obtained over any area is less than that required, the condition shall be remedied, and if additional rollings are ordered, they will be done at no cost to the Owner. If the material itself is unsatisfactory or if additional rolling or other means fails to produce satisfactory results, the area in question shall be removed down to material of satisfactory density and the removal, replacement, and re-rolling shall be done by the Contractor, without additional compensation.
 5. Material compaction by hand-operated equipment or power-driven tampers shall be spread in layers not more than 6 inches thick. The degree of compaction obtained by these tamping operations shall be equal in every respect to that secured by the rolling operation.
- E. Compaction Methods: The Contractor may select any method of compaction that is suitable to compact the material to the required density.
1. General: Whatever method of compacting backfill is used, care shall be taken that stones and lumps shall not become nested and that all voids between stones shall be completely filled with fine material. All voids left by the removal of sheeting shall be completely backfilled with suitable materials and thoroughly compacted.
 2. Tamping or Rolling: If the material is to be compacted by tamping or rolling, the material shall be deposited and spread in uniform, parallel layers not exceeding the uncompacted thicknesses specified. Before the next layer is placed, each layer shall be tamped as required so as to obtain a thoroughly compacted mass. Care shall be taken that the material close to the excavation side slopes, as well as in all other portions of the fill area, is thoroughly compacted. When the excavation width and the depth to which backfill has been placed are sufficient to make it feasible, and it can be done effectively and without damage to the pipe or structure, backfill may, on approval, be compacted by the use of suitable rollers, tractors, or similar powered equipment instead of by tamping. For compaction by tamping or rolling, the rate at which backfilling material is deposited shall not exceed that permitted by the facilities for its spreading, leveling, and compacting as furnished by the Contractor.
- F. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

3.5 GRADING:

A. General:

1. Grading shall consist of that work necessary to bring all areas to the final grades.
2. Uniformly grade areas within limits of work requiring grading, including adjacent transition areas.
3. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Building Lines:

1. Grade areas adjacent to building to drain away from structures and to prevent ponding.
2. Grade surfaces to be free from irregular surface changes, and as follows:
 - a. Lawn or Unpaved Areas: Finish grade areas to receive topsoil to within not more than 1" above or below the required subgrade elevations.
 - b. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 1/2" above or below the required subgrade elevation.
 - c. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 3/8" above or below the required subgrade elevation.

C. Grading Surface of Fill Under Building Slabs:

1. Grade surface to be smooth and even, free of voids, and compacted as specified, to the required elevation.
2. Provide final grades within a tolerance of 1/2" when tested with a 10' straight edge.

D. Compaction:

1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

E. Protection of Graded Areas:

1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
2. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

3.6 BASE COURSE AND LEVELING COURSE

A. General:

1. Base course consists of placing the specified materials in layers to support a leveling course or paved surface, as indicated in the Drawings.

B. Grade Control:

1. During construction, maintain lines and grades including crown and cross-slope of base course and leveling course.

C. Placing:

1. Place base course on prepared subbase conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting base materials.

2. Place leveling course on prepared base course, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compaction.
- D. Shaping and Compacting:
1. All layers of aggregate base course and leveling course shall be compacted to the required density immediately after placing. As soon as the compaction of any layer has been completed, the next layer shall be placed.
 2. The Contractor shall bear full responsibility for and make all necessary repairs to the base leveling courses and the subgrade until the full depth of the base leveling courses is placed and compacted. Repairs shall be made at no additional cost to the Owner.
 3. If the top of any layer of the aggregate base or leveling course becomes contaminated by degradation of the aggregate or addition of foreign materials, the contaminated material shall be removed and replaced with the specified material at the Contractor's expense.

END OF SECTION

SECTION 02485LOAMING & SEEDINGPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish, place, and test topsoil, seed, lime, and fertilizer where shown on the drawings and protect and maintain seeded areas disturbed by construction work, as directed by the Engineer.
- B. Related Work Specified Elsewhere (When Applicable): Earthwork, excavation, backfill, compaction, site grading and temporary erosion control are specified in the appropriate Sections of this Division.

1.2 SUBMITTALS AND TESTING

- A. Seed:
 - 1. Furnish the Engineer with duplicate signed copies of a statement from the vendor, certifying that each container of seed delivered to the project site is fully labeled in accordance with the Federal Seed Act and is at least equal to the specification requirements.
 - 2. This certification shall appear in, or with, all copies of invoices for the seed.
 - 3. The certification shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates and certificates have been approved.
 - 4. Each lot of seed shall be subject to sampling and testing, at the discretion of the Engineer, in accordance with the latest rules and regulations under the Federal Seed Act.
- B. Topsoil:
 - 1. Inform the Engineer, within 30 days after the award of the Contract, of the sources from which the topsoil is to be furnished.
 - 2. Obtain representative soil samples, taken from several locations in the area under consideration for topsoil removal, to the full stripping depth.
 - 3. Have soil samples tested by an independent soils testing laboratory, approved by the Engineer, at the Contractor's expense.
 - 4. Have soil samples tested for physical properties and pH (or lime requirement), for organic matter, available phosphoric acid, and available potash, in accordance with standard practices of soil testing.
 - 5. Approval, by the Engineer, to use topsoil for the work will be dependent upon the results of the soils tests.
- C. Lime & Fertilizer:
 - 1. Furnish the Engineer with duplicate copies of invoices for all lime and fertilizer used on the project showing the total minimum carbonates and minimum percentages of the material furnished that pass the 90 and 20 mesh sieves and the grade furnished.

2. Each lot of lime and fertilizer shall be subject to sampling and testing at the discretion of the Engineer.
3. Sampling and testing shall be in accordance with the official methods of the Association of Official Agricultural Chemists.
4. Upon completion of the project, a final check may be made comparing the total quantities of fertilizer and lime used to the total area seeded. If the minimum rates of application have not been met, the Engineer may require the Contractor to distribute additional quantities of these materials to meet the minimum rates.

1.3 DELIVERY, STORAGE & HANDLING

A. Seed:

1. Furnish all seed in sealed standard containers, unless exception is granted in writing by the Engineer.
2. Containers shall be labeled in accordance with the United States Department of Agriculture's rules and regulations under the Federal Seed Act in effect at the time of purchase.

B. Fertilizer:

1. Furnish all fertilizer in unopened original containers.
2. Containers shall be labeled with the manufacturer's statement of analysis.

1.4 JOB CONDITIONS

A. Topsoil: Do not place or spread topsoil when the subgrade is frozen, excessively wet or dry, or in any condition otherwise detrimental, in the opinion of the Engineer, to the proposed planting or to proper grading.

B. Seeding:

1. Planting Seasons: The recommended seeding time is from April 1 to September 15. The Contractor may seed at other times. Regardless of the time of seeding, the Contractor shall be responsible for each seeded area until it is accepted.
2. Weather Conditions:
 - a. Do not perform seeding work when weather conditions are such that beneficial results are not likely to be obtained, such as drought, excessive moisture, or high winds.
 - b. Stop the seeding work when, in the opinion of the Engineer, weather conditions are not favorable.
 - c. Resume the work only when, in the opinion of the Engineer, conditions become favorable, or when approved alternate or corrective measures and procedures are placed into effect.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Seed:

1. Provide the grass seed mixture approved by the Engineer, having the following composition:
 - a. Park Mixture:
 - i. 50 percent Creeping Red Fescue
 - ii. 30 percent Kentucky Bluegrass

- iii. 20 percent Annual Ryegrass
 - iv. Add 1 pound White or Dutch Clover per acre
 - v. No weed seeds allowed
 - b. Roadside Mixture:
 - i. 50 percent Creeping Red Fescue
 - ii. 15 percent Kentucky Bluegrass
 - iii. 5 percent White Clover
 - iv. 2 percent Red Top
 - v. 3 percent Birdsfoot Trefoil
 - vi. 25 percent Annual Ryegrass
 - vii. Add 1 pound of White or Dutch Clover per acre
 - viii. No weed seeds allowed
 - c. Lawn Areas:
 - i. Kentucky 31 Fescue 25 percent
 - ii. Chewing Fescue 15 percent
 - iii. Creeping Red Fescue 15 percent
 - iv. Pennfine Perennial Rye 25 percent
 - v. Lynn Perennial Rye 10 percent
 - vi. Common Annual Rye 10 percent
 - vii. No weed seeds allowed
 - 2. Do not use seed which has become wet, moldy, or otherwise damaged in transit or during storage.
- B. Topsoil:
- 1. Fertile, friable, natural topsoil typical of the locality, without admixture of subsoil, refuse or other foreign materials and obtained from a well-drained site. Mixture of sand, silt, and clay particles in equal proportions.
 - 2. Free of stumps, roots, heavy of stiff clay, stones larger than 1-inch in diameter, lumps, coarse sand, weeds, sticks, brush or other deleterious matter.
 - 3. Not less than 4 percent nor more than 20 percent organic matter.
 - 4. Topsoil depth shall be 4-inches, unless otherwise indicated.
- C. Lime:
- 1. Provide lime which is ground limestone containing not less than 85% of total carbonate and of such fineness that 90% will pass a No. 20 sieve and 50% will pass a No. 100 sieve.
 - 2. Coarser materials will be acceptable provided the specified rates of application are increased proportionately on the basis of quantities passing a No. 100 sieve. No additional payment will be made to the Contractor for the increased quantity.
- D. Fertilizer:
- 1. Provide a commercial fertilizer approved by the Engineer.
 - 2. Provide fertilizer containing the following minimum percentage of nutrients by weight:
 - 10% Available phosphoric acid
 - 10% Available potash
 - 10% Available nitrogen (75% of the nitrogen shall be organic)

PART 3 - EXECUTION

3.1 PREPARATION

A. Equipment:

1. Provide all equipment necessary for the proper preparation of the ground surface and for the handling and placing of all required materials.
2. Demonstrate to the Engineer that the equipment will apply materials at the specified rates.

B. Soil: Perform the following work prior to the application of lime, fertilizer or seed.

1. Scarify the subgrade to a depth of 2 inches to allow the bonding of the topsoil with the subsoil.
2. Apply topsoil to a depth of 4 inches or as directed on areas to be seeded.
3. Trim and rake the topsoil to true grades free from unsightly variations, humps, ridges, or depressions.
4. Remove all objectionable material and form a finely pulverized seed bed.

3.2 PERFORMANCE

A. Grading:

1. Grade the areas to be seeded as shown on the Drawings or as directed by the Engineer.
2. Leave all surfaces in even and properly compacted condition.
3. Maintain grades on the areas to be seeded in true and even conditions, including any necessary repairs to previously graded areas.

B. Placing Topsoil:

1. Uniformly distribute and evenly spread topsoil on the designated areas.
2. Spread the topsoil in such a manner that planting work can be performed with little additional soil preparation or tillage.
3. Correct any irregularities in the surface resulting from topsoiling or other operations to prevent the formation of depressions where water may stand.
4. Thoroughly till the topsoil to a depth of at least 3 inches by plowing, harrowing, or other approved method until the condition of the soil is acceptable to the Engineer. The surface shall be cleared of all debris and or stones one inch or more in diameter.

C. Placing Fertilizer:

1. Distribute fertilizer uniformly at a rate determined by the soils test over the areas to be seeded.
2. Incorporate fertilizer into the soil to a depth of at least 3 inches by discing, harrowing, or other methods acceptable to the Engineer.
3. The incorporation of fertilizer may be a part of the tillage operation specified above.
4. Distribution by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time will be acceptable.

D. Placing Lime:

1. Uniformly distribute lime immediately following or simultaneously with the incorporation of fertilizer.
2. Distribute lime at a rate determined from the pH test to a depth of at least 3 inches by discing, harrowing, or other methods acceptable to the Engineer.

- E. Seeding:
1. Fine rake and level out any undulations or irregularities in the surface resulting from tillage, fertilizing, liming or other operations before starting seeding operations.
 2. Hydroseeding:
 - a. Hydroseeding may be performed where approved and with equipment approved by the Engineer.
 - b. Sow the seed over designated areas at a minimum rate of 5 pounds per 1000 square feet.
 - c. Seed and fertilizing materials shall be kept thoroughly agitated in order to maintain a uniform suspension within the tank of the hydroseeder.
 - d. The spraying equipment must be designed and operated to distribute seed and fertilizing materials evenly and uniformly on the designated areas at the required rates.
 3. Drill Seeding:
 - a. Drill seeding may be performed with approved equipment having drills not more than 2 inches apart.
 - b. Sow the seed uniformly over the designated areas to a depth of 1/2 inch and at a rate of 5 pounds per 1,000 square feet.
 4. Broadcast Seeding:
 - a. Broadcast seeding may be performed by equipment approved by the Engineer.
 - b. Sow the seed uniformly over the designated areas at a rate of 5 pounds per 1,000 square feet.
 - c. Sow half the seed with the equipment moving in one direction and the remainder of the seed with the equipment moving at right angles to the first sowing.
 - d. Cover the seed to an average depth of 1/2 inch by means of a brush harrow, spike-tooth harrow, chain harrow, cultipacker, or other approved devices.
 - e. Do not perform broadcast seeding work during windy weather.
- F. Compacting:
1. Seeded areas must be raked lightly after sowing unless seeding is to be directly followed by application of an approved mulch.
 2. Compact the entire area immediately after the seeding operations have been completed.
 3. Compact by means of a cultipacker, roller, or other equipment approved by the Engineer weighing 60 to 90 pounds per linear foot of roller.
 4. If the soil is of such type that a smooth or corrugated roller cannot be operated satisfactorily, use a pneumatic roller (not wobbly wheel) that has tires of sufficient size to obtain complete coverage of the soil.
 5. When using a cultipacker or similar equipment, perform the final rolling at right angles to the prevailing slopes to prevent water erosion, or at right angles to the prevailing wind to prevent dust.

3.3 PROTECTION & MAINTENANCE

A. Protection:

1. Protect the seeded area against traffic or other use.
 2. Erect barricades and place warning signs as needed.
- B. Maintenance:
1. At the time of the first cutting, set mower blades two inches high. All lawns shall receive at least two mowings before acceptance. Coordinate schedule for mowing with Engineer.
 2. Maintenance shall also include all temporary protection fences, barriers and signs and all other work incidental to proper maintenance.
 3. Maintain grass areas until a full stand of grass is indicated, which will be a minimum of 45 days after all seeding work is completed and shall not necessarily related to Substantial Completion of the General Contract.
 4. Protection and maintenance of grass areas shall consist of watering, weeding, cutting, repair of any erosion and reseeding as necessary to establish a uniform stand for the specified grasses, and shall continue until Acceptance by the Engineer of the work of this section. It shall also include the furnishing and applying of such pesticides as are necessary to keep grass areas free of insects and disease. All pesticides shall be approved by Engineer prior to use.

3.4 ACCEPTANCE

- A. At final acceptance of the project all areas shall have a close stand of grass with no weeds present and no bare spots greater than three inches (3") in diameter over greater than five percent (5%) of the overall seeded area.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Temporary enclosures.
- B. All rough lumber, including wood nailers, posts, plates, blocking, strapping, and lumber bases for mechanical and electrical equipment
- C. Plywood Sheathing
- D. Wood Trim
- E. PVC Trim.
- F. Rough hardware, such as nails, bolts, screws, clips, as required to install rough carpentry work.
- G. Lumber Preservatives
- H. Sill Sealer

1.2 REFERENCES

- A. American Wood Protection Association (AWPA) u1 - Use Category System - User Specification for Treated Wood.
- B. Plywood shall conform to American Plywood Association APA Grade trademark and Product Standard PS-1.

1.3 QUALITY ASSURANCE

- A. All lumber except as otherwise specified herein shall:
 - 1. Be new, dressed 4 sides (S4S), clean, and free from warping and other defects.
 - 2. Conform to U. S. Department of Commerce Simplified Practice Recommendations R-16 for sizes and use Classifications.
 - 3. Have a moisture content not exceeding 19 percent when delivered to the project.
 - 4. National Forest Products Association - "National Design Specification for Wood Construction - 2005 including Design Values for Wood Construction".
- B. Plywood shall conform to American Plywood Association APA Grade Trademark and Product Standard PS-1.

1.4 SUBMITTALS

- A. Submit product data under provision of Section 01340.
- B. Submit plywood thickness, grade and structural type.
- C. Submit PVC trim.
- D. Submit each type of fastener to be used with the location for use.
- E. Submit sill sealer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store all materials in an elevated dry location, protected by waterproof coverings. Do not store within the building until masonry, concrete, and other such wet work has been completed and allowed to dry.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. PVC Trim
 - 1. AZEK Exteriors
 - 2. Kleer Trimboards
 - 3. Versatex Trimboards
 - 4. Or equal

2.2 LUMBER TREATMENTS

- A. Preservative Treatments: All dimension lumber, wood blocking and nailers which will be embedded in or in contact with concrete and masonry or concealed by roofing, flashing and the air barrier system and any wood indicated on the drawings as preservative treated (PT) shall be treated with waterborne preservatives in accordance with AWPA Standard U1 to the requirements of Category 2 (UC2).
- B. Brush Preservative Treatment: Brush coat all end cuts after cutting with treatment equal to above. Apply in two heavy coats on all surfaces prior to installation of lumber.

2.3 FRAMING, FURRING AND BLOCKING

- A. All dimensional lumber to be Spruce-Pine-Fir No. 2 or better unless indicated otherwise on the Structural Drawings.
- B. All preservative treated dimensional lumber to be southern yellow pine, No. 1 or better, unless indicated otherwise.
- C. Furring and other lumber less than 1-1/2 inches in thickness to be No. 2 spruce or Douglas fir.
- D. Blocking less than 1-1/2" in thickness to be exterior grade plywood.

2.4 SHEATHING

- A. Plywood Sheathing shall be thicknesses, exposure rating and structural type indicated on the Drawings.

2.5 WOOD PANELS

- A. Plywood Panels for Electrical Panel Mountings to be INT DFPA A-C, 3/4 inch thick.
- B. MDO plywood base for exterior mounted electrical equipment.
- C. Interior Finish Plywood to be APA ACX in thickness indicated on the Drawings.

2.6 PVC TRIM

- A. Material: Free Foam Cellular PVC material with a small-cell microstructure and density of .55 grams/cm³.
- B. Performance and physical characteristic requirements:
 - 1. Density: 0.55 g/cm³, ASTM D 792
 - 2. Water Absorption: <0.70 %, ASTM D 570
 - 3. Tensile Strength: 1889 psi, ASTM D 638
 - 4. Tensile Modulus: 107,000 psi, ASTM D 638
 - 5. Flexural Strength: 4019 psi, ASTM D 790
 - 6. Flexural Modulus: 164,200 psi, ASTM D 790

7. Modulus of Elasticity: 97,400 psi, ASTM D 638
 8. Elongation: 10.2 %, ASTM D 638
 9. Nail Hold: 108 Lbf/in of penetration, ASTM D 1761
 10. Screw Hold: 442 Lbf/in of penetration, ASTM D 1761
 11. Staple Hold: 69 Lbf/in of penetration, ASTM D 1761
 12. Gardner Impact: 98 In-lbs, ASTM D 5420
 13. Notched Izod Impact: 0.250 Ft-lbs/inch, ASTM D 256
 14. Coefficient of Linear Expansion: 3.25×10^{-5} in/in/°F, ASTM D 696
 15. Burning Rate: Failed to Ignite, ASTM D 635
 16. Flame Spread Index: 25, ASTM E 84
 17. Heat Deflection Temp (264 psi): 153 °F, ASTM D 648
 18. Oil Canning (@ 140 °F): Passed, ASTM D 648
- C. Sizes as indicated on the drawings and in the longest lengths available.

2.7 HANGERS AND ANCHORS

- A. Joist hangers, framing anchors, nail plates and other fasteners as indicated on Drawings. Truss Seismic and Hurricane Anchors are specified in Section 06190 Prefabricated Wood Trusses.
- B. Expansion anchor and anchor bolts shall be as shown on the Drawings and as specified in Section 05500. For other non-specified conditions, the following minimums shall apply:
 1. Other nailers and blocking in excess of 7/8 inch thick - 3/4-inch diameter galvanized steel anchor bolts or expansion bolts, as applicable.
 2. Furring, strapping and blocking 7/8 inch thick or less attached to concrete or masonry - 5/16 inch diameter galvanized steel anchor bolts or expansion bolts.
 3. Secure other non-specified lumber with galvanized steel fasteners, of a type most suitable for the application.

2.8 FASTENERS

- A. Fasteners for PVC trim shall be stainless steel.
- B. Hardware and fasteners in contact with pressure treated lumber shall be stainless steel.

2.9 SILL SEALER

- A. Sill Sealer: Closed cell foam, 1/4-inch by width of 2x plate and in 50-foot rolls.

PART 3 - EXECUTION

3.1 TEMPORARY BRACING

- A. Provide and maintain, until such time as permanently built into the structure, all temporary bracing for walls, door frames, sills, and other work requiring bracing and which is not specified as being provided under other SECTIONS of the specifications.

3.2 PROTECTION

- A. Do such work as is necessary to cover and protect all finishes and other work from damage during construction.

3.3 SILL SEALER

- A. Install sill sealer, same width as 2x plate, between all wood framing/blocking and masonry/concrete.

3.4 NAILERS AND BLOCKING

- A. Fasten nailers and blocking to concrete and masonry with specified bolts, as shown on Drawings or as specified above. Space bolts not over 32 inches on center. Stagger lines of bolts on nailers wider than nominal 3-1/2 inch width. Use not less than two (2) bolts per piece of nailer length. Counterbore nailers so that nut and ends of bolts are recessed below top surface. Install wood shims behind nailers and blocking against masonry, as required, to ensure completely true surface.

3.5 FRAMING AND SHEATHING

- A. Install plywood sheathing, stagger all joints and block all edges with 2x6.
- B. Nailing shall be as per the nailing schedule.
- C. All plywood shall be installed such that the long direction is perpendicular with the main framing members.

END OF SECTION

SECTION 07311ASPHALT SHINGLESPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Asphalt Shingles
- B. Underlayment
- C. Ridge Vents
- D. Vent stack roof flashing
- E. Drip Edge
- F. Aluminum Roof Flashing

1.2 REFERENCES

- A. ASTM A 653/A 653M – Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron-Alloy-Coated (Galvannealed) by the Hot-Dip Process
- B. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- C. ASTM B 370 – Standard Specification for Copper Sheet and Strip for Building Construction.
- D. ASTM D 225 – Standard Specification for Asphalt Shingles (Organic Felt) Surfaced with Mineral Granules.
- E. ASTM D 226 – Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- F. ASTM D 1970 – Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials used as Steep Roofing Underlayment for Ice Dam Protection.
- G. ASTM D 3018 – Standard Specification for Class A Shingles Surfaced with Mineral Granules.
- H. ASTM D 3161 – Standard Test Method for Wind Resistance of Asphalt Shingles (Fan-Induced Method).
- I. ASTM D 3462 – Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules.
- J. ASTM D 4586 – Standard Specification for Asphalt Roof Cement, Asbestos-Free.
- K. ASTM D-4869 – Standard Specification for Asphalt-Saturated Organic Felt Shingle Underlayment Used in Roofing.
- L. ASTM D 6757 – Standard Specification for Inorganic Underlayment for Use with Steep Slope Roofing Products.
- M. ASTM D7158 – Standard Test Method for Wind Resistance of Asphalt Shingles (Uplift Force/Uplift Resistance Method)
- N. ASTM E 108 – Standard Test Methods for Fire Test of Roof Coverings
- O. ASTM G 21 – Determining Resistance of Synthetic Polymers to Fungi

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 01340.
- B. Submit samples of actual material indicated for the work in all colors and textures available from manufacturers full range of color options for selection by Architect.
- C. Manufacturer's printed literature for review (CSI "Spec-Data" sheet or equivalent) stating product information correlated to specified requirements.
- D. Copies of the manufacturer's specifications and installation instructions.

1.4 QUALITY ASSURANCE

- A. Installer Minimum Qualifications: Installer shall be licensed or otherwise authorized by all federal, state and local authorities to install all products specified in this section. Installer shall perform work in accordance with NRCA Roofing and Waterproofing Manual. Work shall be acceptable to the asphalt shingle manufacturer.
- B. Maintain one copy of manufacturer's application instructions on the project site.
- C. Store Products in manufacturer's unopened packaging until ready for installation.
- D. Deliver shingles to site in manufacturer's unopened labeled bundles. Promptly verify quantities and conditions. Immediately remove damaged products from site.

1.5 PROJECT CONDITIONS

- A. Proceed with installing asphalt shingles only when existing and forecasted weather conditions will permit work to be performed according to manufactures' recommendations and warranty requirements, and when substrate is completely dry. Roofing shall not be applied when ambient air and substrate temperatures are less than 40 deg F.
- B. Do not begin roofing installation until substrate has been inspected and determined to be in satisfactory condition in accordance with manufactures warranty requirements. All surfaces shall be smooth, dry, clean and free of sharp edges, loose or foreign materials, oil or grease. No work shall proceed when moisture is present on the roof or substrate material.
- C. Underlayment shall not be left exposed for more than 30 days per the manufactures requirements. Material left exposed for more than 30 days shall be removed and replaced.

1.6 WARRANTY

- A. Manufacturer's Warranty: Furnish shingle manufacturer's warranty for the product listed below:
 - 1. Lifetime limited warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Certaineed
- B. Owens Corning
- C. GAF
- D. Or equal.

2.2 MATERIALS

- A. Shingles - Fiberglass Asphalt Base ASTM D3018 Type 1 – Self-Sealing UL Certification of ASTM D3462, ASTM D3161/UL997 " Class "H" Wind Resistance and UL Class A Fire Resistance, glass fiber mat base, ceramically colored/UV resistant mineral surface granules across entire face of shingle; algae-resistance; two piece laminate shingle; Color as selected by Architect.
 - 1. Certainteed Corporation; Landmark Premium
 - 2. Owens Corning; Duration
 - 3. GAF; Timberline HD
- B. Underlayment:
 - 1. Ice and Watershield: ASTM D1970 sheet barrier of self-adhering rubberized asphalt membrane shingle underlayment having internal reinforcement and “split” back plastic release film; provide material warranty equal in duration to that of shingles being applied as recommended by manufacturer.
 - 2. Synthetic Underlayment: Synthetic underlayment designed for use on roof decks as a water-resistant layer below roofing, meeting ASTM D4869, ASTM E108 and ASTM E96.
- C. Ridge Vents – 12” Shingle topped ridge vent with 18 square inches net free vent area per lineal foot.
- D. Nails – Standard round wire type roofing nails; Hot dipped galvanized of length adequate to penetrate plywood deck and having a minimum 11 or 12 gauge shank diameter and minimum head diameter of 1/2 inch.
- E. Drip Edge – ASTM B209 0.025 thick aluminum, prefinished, formed as detailed on the Drawings.
- F. Roof Flashing - 0.024- thick aluminum, prefinished, as detailed on the Drawings.
- G. Vent Pipe Flashing – Pipes penetrating shingle roof shall have self-sealing neoprene collar with aluminum flashing.
- H. All formed sheet metal flashing and trim shall conform to "Sheet Metal and Air Conditioning Contractors National Association, Inc. - Architectural Sheet Metal Manual".
- I. Hem all exposed edges.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION CONDITIONS

- A. The Contractor shall be responsible for the providing of proper receiving surfaces for roofing and flashing items. Inspect all surfaces receiving roofing and flashing work and correct all defects or other characteristics in the new receiving surfaces which may be detrimental to the installation and performance of the items to be furnished and installed hereunder. Do not commence work until defects have been corrected. Commencement of roofing and flashing work shall constitute acceptance by the Contractor of surface conditions. The Contractor shall be responsible for leakages in roof and flashed surfaces and any other defects in these surfaces.
- B. Ensure that all openings through the roof decks for fans, vents, and other such items, have been either temporarily or permanently covered, to prevent the entry of water into the building, prior to commencing the Work.

- C. Have sufficient materials on the project to complete each day's work. The complete roofing system for any one section of the roof, must be finished by the end of each day. Phased roofing operations will not be permitted. Do not leave shingles exposed to the weather overnight or when inclement weather is imminent.

3.2 UNDERLAYMENT INSTALLATION

- A. Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated.
- B. Install ice and watershield per manufactures requirements 3 ½ inch side lap and 6-inch head a lap. Stagger 24 inches between courses; and as indicated below.
 - 1. At eaves, provide 66-inches (two rows with 6-inch side laps).
 - 2. At rakes, provide 36-inches (one row).
 - 3. At valleys, provide 96-inches centered on the valley (three rows with 6-inch side laps).
 - 4. At ridges and hips provide 66-inches centered on the ridge (two rows with 6-inch side laps).
 - 5. At all roof penetrations, 36 inches an all directions.
 - 6. At additional locations, as indicated on the Drawings.
- C. Where ice and watershield is not required, install synthetic underlayment laid in a shingled pattern overlapping half the width of each sheet. Install with a six-inch lap over ice and watershield. Nail with specified nails spacing not to exceed 12 inches in any direction.

3.3 FLASHING INSTALLATION

- A. Drip Edge: install beneath underlayment and fasten to roof deck.
- B. Pipe Flashing: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to shingles as recommended by the manufacture.

3.4 SHINGLE INSTALLATION

- A. Apply shingles in strict accordance with the shingle manufacturer's instructions and recommendations.
- B. Install starter strip along lowest roof edge, consisting of asphalt shingle strip with tabs removed with self-sealing strip face up at roof edge.
- C. Extend asphalt shingles ¼-inch over fascia drip edge at eaves and rakes.
- D. Install asphalt shingles stair-stepping across the roof deck with manufactures recommended offset pattern, maintaining uniform exposure.
- E. Fasten asphalt shingles with a minimum of six nails per shingle, nails long enough to penetrate plywood sheathing. Ridge Vent: Install continuous ridge vent over asphalt shingles according to manufactures instructions. Run full length of ridge. Fasten with roofing nails of sufficient length to penetrate sheathing.
- F. Ridge Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing. Fasten ridge cap shingles to cover ridge vent without obstructing airflow.

3.5 CLEANING

- A. At the completion of the Work, clean and remove from the site, all rubbish and accumulated materials and leave the Work in a satisfactory condition.
- B. Clean, remove, or replace, as directed by the Engineer, all stains and/or damage to the exterior finish of building caused by faulty workmanship and/or improper handling of materials in regard to the installation of roofing and flashing work.

END OF SECTION

SECTION 07712GUTTERS AND DOWNSPOUTSPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Aluminum Gutters, Downspouts and accessories

1.2 REFERENCES

- A. SMACNA - Architectural Sheet Metal Manual
- B. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate

1.3 SUBMITTALS

- A. Submit product data under provision of Section 01340.
- B. Submit large scale shop drawings detailing gutters, downspouts and accessories including all splice plates and method of anchorage.
- C. Submit samples of actual material indicated for the work in all colors and textures available from manufacturers full range for color selection by Architect.
- D. Submit manufacturers catalog cuts, spec data sheets, and installation instructions.
- E. Submit installer's qualifications for review by Engineer.

1.4 QUALITY ASSURANCE

- A. Field measurements shall be taken prior to fabrication to assure symmetry and verify as built conditions.
- B. All sheet metal flashing and trim shall be fabricated and installed in accordance with the recommendations in the SMACNA - Architectural Sheet Metal Manual.
- C. All materials shall be installed with concealed starter cleats and splice plates to accommodate thermal movement. Exposed through nailing or face nailing is not allowed.
- D. Hem all exposed edges.
- E. The Contractor shall obtain the services of an installer with a minimum of 10 years of experience of working with the materials specified.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials with a protective vinyl masking.
- B. Store all materials in properly protected and dry storage facilities until ready for use. Do not use materials which have been damaged in any manner.
- C. Protect work from damage during construction period so that it will be without any indication of abuse or damage at time of acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S

- A. Atas International Inc.
- B. Dimensional Metals Inc.
- C. Englert Inc.
- D. Or equal

2.2 GUTTERS, DOWNSPOUTS, AND ACCESSORIES

- A. Gutters shall be seamless 0.032 aluminum 5-inch K series gutters.
- B. Downspouts shall be 3-inch by 4-inch 0.032 aluminum.
- C. Heavy duty hidden hangers.
- D. Straps, endcaps, and accessories as required for a complete system.
- E. Drainage screen for leaf protection.

2.3 FINISH

- A. Unless indicated otherwise, finish on all materials shall have a fluoropon resin finish, color selected by Engineer. Texture shall be smooth.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect all surfaces and notify general contractor of any defects or other characteristics which may be detrimental to the installation and performance of the materials to be installed.
- B. Commencement of work shall constitute acceptance of surface conditions.
- C. Field verify all dimensions of the prefabricated items prior to fabrication to ensure ease of installation with a proper and tight fit.

3.2 INSTALLATION

- A. Install in strict accordance with manufacturer's instructions and as detailed on the Drawings.

END OF SECTION

SECTION 07920

JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Preparing sealant substrate surfaces.
- B. Sealant and backing.

1.2 REFERENCES

- A. ASTM C790 - Recommended Practices for Use of Latex Sealing Compounds.
- B. ASTM C920 - Specification for Elastomeric Joint Sealant
- C. ASTM C834 - Specification for Latex Sealing Compounds
- D. FS-TT-S-227 - Sealing Compound: Elastomeric Type, Multi-Component
- E. FS-TT-S-230 - Sealing Compound: Elastomeric Type, Single Component
- F. FS-TT-S-001543 - Sealing Compound: Silicone Rubber Base
- G. Sealing and Waterproofers Institute - Sealant and Caulking Guide Specification

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 01340.
- B. Submit manufacturer's installation instructions.
- C. Submit Joint Sealant Schedule indicating each specific item/location to be sealed with the following information:
 - 1. Joint sealant application/location.
 - 2. Joint sealant manufacturer and product name.
 - 3. Joint design including width and depth of joint sealant and backer rod or bond-breaker size and location.
 - 4. Primer required for each substrate.
 - 5. Solvent cleaner for each substrate type.
- D. Submit samples of actual material indicated for the work in all colors and textures available from manufacturers full range for color selection by Architect.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum ten years' experience.
- B. Applicator Qualifications: Company specializing in applying the work of this Section with minimum five years' experience.
- C. Compatibility: Verify sealants used are compatible with joint substrates.
- D. Joint Tolerance: Compliance with the manufacturer's limitation is required.
- E. Conform to Sealant and Waterproofers Institute requirements for installation.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
- B. VOC Standards - All sealants shall be in accordance with all applicable State and Federal VOC standards.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate work in this Section with related sections.

1.7 WARRANTY

- A. Installer to provide five-year warranty to include coverage of installed sealants, caulking and accessories which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Joint Sealer Type 1: Typical horizontal and vertical joints up to 1-inch at openings, control joints in masonry, penetrations through walls and ceilings, etc.
1. Moisture cured, single component, polyurethane-based, non-sag elastomeric sealant, ASTM C920, Grade NS.
 2. Max joint size: 1-inch.
 3. Movement capability: 35% joint movement.
 4. Products:
 - a. Bostik 915 Polyurethane Sealant
 - b. Sika Sikaflex 1A
 - c. Tremco Dymonic 100
 - d. Or equal.
- B. Joint Sealer Type 5: Sealant for high temperature applications around generator exhausts, blower ductwork, chimney caps, etc.
1. Single component, non-sag, acetoxysilicone RTV sealant.
 2. Movement capability: 25% joint movement.
 3. Service Temperature: Up to 400 degrees Fahrenheit.
 4. Products:
 - a. Bostik BOSTI-SIL 25 RTV Silicone Sealant
 - b. Dow High Temp 100% RTV Silicone Sealant
 - c. Tremco TremPro 644 RTV
 - d. Or equal.

2.2 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: ASTM D1056; round, closed cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width as recommended by sealant manufacturer.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

2.3 COLORS

- A. As selected by engineer from manufacturers full range of color options.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and joint openings are ready to receive work and field measurements are as shown on Drawings and recommended by the manufacturer.
- B. Beginning of installation means installer accepts existing conditions.

3.2 PREPARATION

- A. Clean and prime joints in accordance with manufacturer's instructions.
- B. Remove loose materials and foreign matter which might impair adhesion of sealant.
- C. Verify that joint backing and release tapes are compatible with sealant.
- D. Perform preparation in accordance ASTM C790 for latex base sealants.
- E. Protect elements surrounding the work of this Section from damage or disfiguration.

3.3 INSTALLATION

- A. Install sealant in strict accordance with manufacturer's instructions.
- B. Measure joint dimensions and size materials to achieve required width/depth ratios.
- C. Install joint backing to achieve a neck dimension no greater than 1/3 the joint width.
- D. Install bond breaker where joint backing is not used.
- E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot apply within these temperature ranges.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Tool joints concave.

3.4 CLEANING AND REPAIRING

- A. Clean work under provisions of Section 01710.
- B. Clean adjacent soiled surfaces.
- C. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.5 PROTECTION OF FINISHED WORK

- A. Protect sealants until cured.

END OF SECTION

SECTION 08110HOLLOW METAL DOORS AND FRAMESPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Steel Doors.
- B. Steel Frames.

1.2 REFERENCES

- A. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
- B. ANSI/NAAMM/HMMA 867-06 - Guide Specifications for Commercial Laminated Core Hollow Metal Doors and Frames.
- C. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
- D. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
- E. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
- F. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
- G. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- H. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
- I. ANSI/SDI A250.13 - Testing and Rating of Severe Windstorm Resistant Components for Swing Door Assemblies.
- J. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- K. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- L. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- M. ASTM C1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
- N. ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Doors Under Specified Pressure Differences Across the Specimens.
- O. ASTM E1332 - Standard Classification for Determination of Outdoor-Indoor Transmission Class.
- P. ASTM E1886 - Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials.
- Q. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes.
- R. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection

Association.

- S. NFPA 105: Standard for the Installation of Smoke Door Assemblies.
- T. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
- U. NFRC 102 – Procedure for Measuring the Steady State Thermal Transmittance of Fenestration Systems.
- V. NFRC 400 – Procedure for Determining Fenestration Product Air Leakage.
- W. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
- X. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 01340.
- B. Submit sections 08110 - Hollow Metal Doors and Frames and 08710 - Finish Hardware concurrently.
- C. Submit a complete door and frame schedule, large scale details of door and frame construction, indicating all gauges, reinforcing, cutouts, anchors and anchor clips.
- D. Do not fabricate hollow metal work without final shop drawing review.
- E. Submit manufacturers certification that door and frame hardware reinforcing gauges comply to ANSI/SDI 100.
- F. Submit verification that all existing dimensions and conditions have been field verified.
- G. Submit compliance with ASTM E1886 and ASTM E1996.

1.4 QUALITY ASSURANCE

- A. Conform to requirements of SDI-100.
- B. Labeled door and frame construction to conform to NFPA 250.
- C. Install door and frame assembly to conform to NFPA 80 for labeled glass indicated on door schedule.
- D. Doors and frames shall be factory fabricated. All field modifications shall be approved by the Engineer.
- E. Exterior doors and frames shall conform to the requirements of ASTM E1886 and ASTM E1996.

1.5 QUALIFICATIONS

- A. Sections 08110 - Hollow Metal Doors and Frames and 08710 - Finished Hardware shall be provided by a single supplier.

1.6 PACKAGING

- A. Doors shall be fully wrapped in corrugated cardboard, single faced paper 42-pound with a 26-pound liner medium "B" flute, protecting all surfaces of the door. Flute shall be run the full height of the door.
- B. Wood strips, 3/8 inches, 2 inches commercial grade, finished one side for marking, extending 1/2 inch beyond the top and bottom of the door shall be temporarily applied to the edges of the door.
- C. The corrugated cardboard and wood strip shall be held firmly in place by three (3) 3/8 inch by 18 GA steel bands on each door.

- D. Wood strips shall be marked clearly giving door type, size, hand lock preparation, and mark number. The metal banding shall not interfere with the marking.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver doors, frames, and windows to the job site in manufacturer's unopened packaging.
- B. Store doors and frames upright in a protected area on wood runners or skids and covered with vented plastic.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Curries
- B. Mesker
- C. Steel Craft
- D. Or equal

2.2 DOOR CONSTRUCTION

- A. 6 Panel doors shall be 18-gauge stretcher level steel, 6 panel steel embossed A60 galvanized face sheets.
- B. All other hollow metal door shall be 16-gauge stretcher level steel, A60 galvanized face sheets.
- C. 1/8-inch bevel in two inches on hinge and lock edge.
- D. Seams shall be continuously welded and ground smooth.
- E. Top and bottom 16 gauge, cold-rolled steel reinforcing channels spot welded within door.
- F. Mortise and reinforce doors for finish hardware in accordance with template. Requirements are furnished under finish hardware.
- G. Hinge reinforcement – 12-gauge, channel shape.
- H. Lock face, flush bolts, surface mounted closers - 14 gauge
- I. All other surface mounted hardware - 14 gauge.
- J. Provide flush top cap sealing against water on all exterior doors.
- K. Prepare exterior door bottoms to receive door bottoms.
- L. Doors shall have, rigid polystyrene foam board, bonded to the inside of both faces. The strength developed on the laminated assembly shall be 1500 PSF in compression and a shear strength of not less than 2500 PSF. R-6.37 minimum.
- M. Any additional modifications to specified door construction, as required by Underwriters Laboratories and National Board of Fire Underwriters, to meet required fire rating, shall be performed at the factory, and doors must bear the U.L. seal for each rating so required.

2.3 FRAME CONSTRUCTION

- A. Frames: 14 gauge, A60 galvanized.
- C. All exterior frame joints and interior frames installed in masonry shall be continuously welded and ground smooth. Where galvanized coating has been burned

or damaged, touch up with a cold galvanizing compound. All joints in frame shall be watertight.

- D. Frames for drywall construction shall be knocked-down type with double return backbend as detailed on the Drawings.
- E. Knocked-down frames shall have a mechanical connection at the joints, which when assembled positively aligns the head with the jambs. Corners shall have tight, precision mitered joints with no exposed rivets or screws.
- F. Hinge, Lock and Strike Reinforcement - 10 Gauge
- G. Door Closer Reinforcement - 14 Gauge
- H. Floor Clips - 18 GA minimum
- I. Frame Anchors - Provide minimum three anchors per jamb as required for the adjoining wall construction; a base angle and one anchor for every 2 vertical feet. Provide anchors of not less than 7-gauge steel or 3/16-inch diameter wire adjustable. Provide existing wall type anchors at concrete, all existing openings and where indicated on the drawings.
- J. Frame Splines - Same as frame
- K. Reinforcement, stiffeners, and base angle clips shall be welded to inside surfaces of frames.
- L. Locate hardware cutouts and reinforcing from templates obtained from the hardware supplier. Weld sheet steel dust covers over all cutouts in frames to prevent contact of mortar with reinforcing and lock strikes.
- M. Turn edges of frames to form retainers for anchors.
- N. Punch three (3) holes in top of strike jamb of door frames for application of silencers. Punch two (2) holes in head frame for pairs of doors.
- O. Before shipping, provide removable angle spreaders securely fastened to bottom of each jamb; do not remove until frames are secured in place.
- P. Provide 12-gauge minimum reinforcing to sidelight/door divider.

2.4 FINISHING

- A. Clean all surfaces of doors, frames, anchors and related items specified hereunder, by hot or cold phosphate treatment standard with the manufacturer. Following cleaning, apply one coat of rust-inhibitive prime paint and bake on. Prime all surfaces, including those which will be inaccessible after erection.
- B. The finished work shall be strong and rigid, neat in appearance, and free from warp and buckle. Miters shall be well formed and in true alignment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install frames in accordance with Steel Door Institute.
- B. Provide insulation in frames at exterior frames.
- C. Install doors in accordance with Door Hardware Institute.
- D. Coordinate with Masonry Wall Construction for anchor placement.
- E. Erect all frames in accordance with the final shop drawings and frame schedule.
- F. Provide rigid temporary bracing for door frames as required to ensure maintenance of positioning and remove only after frames have been permanently anchored.

- G. Coordinate installation of glass and glazing.
- H. Receive, store, and be responsible for hardware as furnished under Section 08710, Finish Hardware.
- I. Fit all hinged doors to their respective openings.
- J. Fit all hardware accurately, from templates supplied with hardware, apply securely, and adjust carefully.
- L. Prior to Substantial Completion of the Contract, and before building is occupied, inspect entire building with the Engineer and see that each piece of finish hardware is undamaged and in perfect order and that the proper key for each lock is identified.

3.2 TOLERANCES

- A. Maximum diagonal frame distortion: 1/16 inch measured with straight edge, corner to corner.

3.3 ADJUSTMENTS

- A. Adjust hardware for smooth and balanced door movement.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Finish Hardware for all doors
- B. Keying to coordinate with the Owner's existing master key system.

1.2 REFERENCES

- A. ANSI A115 - Standards for Door and Frame Preparation
- B. ANSI A156 - Standards for Finish Hardware
- C. Other Applicable Life Safety and Building Codes.
- D. NFPA 80 - Fire Doors and Windows
- E. ANSI A117.1 - American National Standard, providing accessibility and usability for physically handicapped people.
- F. ADA - Americans with Disabilities Act.
- G. BHMA – Builders Hardware Manufacturer's Association
- H. UL – Underwriters Laboratories

1.3 SUBMITTALS

- A. The finish hardware supplier shall submit for review a complete and detailed finish hardware schedule using a vertical typewritten format. The finish hardware schedule shall contain a listing of the name of each manufacturer and the product listing for the series included in the hardware schedule.
- B. Submit sections 08110 - Hollow Metal Doors and Frames and 08710 - Finish Hardware concurrently.
- C. Provide catalog cuts on specified hardware.
- D. It shall be the responsibility of the finish hardware supplier to obtain from the owner or the owner's representative, a detailed keying schedule listing the respective key symbol and location for the locksets having the corresponding key symbol.
- E. The finish hardware supplier shall make available to the general contractor a detailed list of template numbers and templates required for each of the door manufacturers that require templates.
- F. Submit the finished hardware suppliers field report indicating that the finished hardware has been installed and is working properly. The report shall note all deficiencies and conditions required to correct them. Refer to "Field Quality Control" as specified herein.

1.4 QUALITY ASSURANCE

- A. The hardware supplier shall have in their employ an architectural hardware consultant (AHC) or a person with equivalent number of years required for AHC qualifications. This person shall be recognized as having the ability to be fully responsible for the scheduling, detailing and execution of this section of the

specifications and related items. This qualified consultant shall be responsible for processing all submissions, correspondence, technical matters related to the finish hardware and its application specified in this section.

- B. All door hardware shall comply with the Americans with Disabilities Act, ANSI A117.1 and applicable state accessibility codes.

1.5 QUALIFICATIONS

- A. Sections 08110 - Steel Doors and Frames and 08710 - Finished Hardware shall be provided by a single supplier.

1.6 DELIVERY, STORAGE AND HANDLING

- A. The finish hardware shall be delivered to the job site and received there by the General Contractor. The General Contractor shall prepare a locked storage room with adequate shelving, for all hardware. The storage room shall be in a dry, secure area, and shall not include storage of other products by other trades.
- B. All finish hardware shall have the necessary screws, bolts and other fastenings required for correct installation of each item. The cylinders, locksets, exit devices, door closers, shall be clearly marked with the respective individual door or heading number.
- C. After the hardware has been installed and prior to the acceptance of the building by the Owner, it shall be the General Contractors responsibility to properly protect the hardware and the hardware finish from all dents, scratches, defacing that may occur during the construction period. Hardware that is considered damaged or scratched during the construction period shall be replaced by the General Contractor at no cost to the owner or hardware supplier. Hardware items with paint on them shall be cleaned and/or replaced by the General Contractor at no charge to the owner.

1.7 WARRANTY

- A. The finish hardware specified for this project shall be guaranteed against defects in material and workmanship for a minimum one (1) year from date of completion and acceptance of this building unless otherwise specified below. In addition, door closers and exit devices shall carry a minimum guarantee of five (5) years from date of completion and acceptance of this building. Mortise locksets shall have a minimum ten (10) year limited warranty. Two (2) year limited warranty on electrified locks. Door closers shall have a minimum twenty-five (25) year limited warranty.
- B. If an item of hardware is found to be defective by reasons of defects in material and workmanship, it shall be replaced by the hardware supplier at no charge to the owner. The installation of the replacement item shall be the responsibility of the General Contractor if within the building guarantee period specified under general conditions, or by the Owner if beyond the building guarantee period.

1.8 MAINTENANCE SERVICE

- A. Provide special wrenches and tools applicable to each different or special hardware component.
- B. Provide maintenance tools and accessories supplied by hardware component manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Hinges
 - 1. Hager
 - 2. Ives
 - 3. McKinney
 - 4. Stanley
 - 5. Or equal
- B. Locksets
 - 1. Schlage
 - 2. Sargent
 - 3. Best
 - 4. Or equal
- C. Exit Devices
 - 1. Sargent
 - 2. Von Duprin
 - 3. Precision
 - 4. Or equal
- D. Door Closers
 - 1. Sargent
 - 2. LCN
 - 3. Dorma
 - 4. Or equal
- E. Kick Plates
 - 1. Burns
 - 2. Rockwood
 - 3. Trimco
 - 4. Or equal
- F. Flush Bolts
 - 1. Burns
 - 2. Rockwood
 - 3. Trimco
 - 4. Or equal
- G. Thresholds
 - 1. National Guard Products
 - 2. Reese
 - 3. Pemko
 - 4. Or equal
- H. Weather Stripping
 - 1. National Guard Products
 - 2. Pemko
 - 3. Reese
 - 4. Or equal

2.2 HINGES

- A. All hinges for this project shall be stainless steel, ball bearing type, and shall meet

or exceed requirements of ANSI A5112.

- B. The following is a guide for hinge size and type required for this specification:

1-3/4 inch Doors up to 3'0" wide	Stanley Hager McKinney Ives	FB191-4 1/2 inches BB1191-4 1/2 inches TB2314-4 1/2 inches 5BB1-4 1/2 inches
1-3/4 inch Doors over 3'0" wide	Stanley Hager McKinney Ives	FB199-4 1/2 inches BB1199-4 1/2 inches T4A3386-4 1/2 inches 5BB1HW-4 1/2 inches

1. The width of hinges shall be sufficient to clear all trim.
 2. Hinges of foreign manufacture shall not be considered acceptable for this project.
- C. Two hinges shall be provided for each door leaf up to and including five feet (5'0") in height. An additional hinge shall be required for each additional two and one half feet (2'-6") or fraction thereof in height.
- D. All exterior doors, and any interior doors so indicated in hardware sets, shall be furnished with non-removable pins (NRP).
- E. Refer to finish section for hinge finish.

2.3 MORTISE LEVER HANDLE LOCKSETS

- A. Locksets for this project shall be mortise type with solid cast stainless steel lever handle sectional trim.
- B. Lock functions shall be manufactured in a single-sized case formed from 12 gauge steel minimum.
- C. Lock cases shall be closed on all sides and back
- D. Locks shall have field adjustable, beveled, armored front, with a 0.125" thickness minimum.
- E. Locks shall have a one piece 3/4" throw anti-frictional stainless steel latch.
- F. Locks shall have a brass 6-pin cylinder, standard.
- G. Locks shall meet or exceed the requirements of ANSI/BHMA A156.13 Series 1000, Operational Grade 1 and Security Grade 1 with all standard trims.
- H. Locks shall comply with UL10C positive pressure requirements.
- I. The following is a guide to the manufacturers and designs acceptable for this project:

Schlage	L9000	Series	L06	Design
Sargent	8200	Series	LNL	Design
Best	45H	Series	15R	Design

- J. Locksets for labeled fire doors shall have a fusible link or other mechanism to prevent latch bolt retraction in the event of fire.
- K. Locks required for fire doors shall be listed by UL for ratings of A label (3 hours) and less, for doors up to 4'-0" x 10'-0" and pairs of doors 8'-0" x 10'-0".

- L. The following is a list of lock functions as indicated under "hardware sets":

<u>FUNCTION</u>	<u>BEST</u>	<u>SARGENT</u>	<u>SCHLAGE</u>
A (Storeroom)	D	04	80
B (Office)	AB	05	50
C (Passage)	N	15	10
D (Classroom)	R	37	70
E (Public)	C	16	60
F (Bathroom)	LT	65	40
G (Deadbolt)	WD	22	62
H (Utility)	ZD	31	80

2.4 EXIT DEVICES

- A. All exit devices for this project shall be of the same series and design and shall be manufactured by one manufacturer.
- B. Exit devices shall be certified to meet or exceed the requirements of ANSI/BHMA A156.3 Grade 1.
- C. Exit devices shall comply with UL10C positive pressure requirements.
- D. All exit devices shall have a 14-gauge, stainless steel continuous horizontal mounting rail with a 16-gauge, stainless steel touch pad with a Lexan touch pad protection plate and shall be of the same design, and of similar configuration, for all doors throughout.
- E. The chassis shall be a solid cast pressure formed almag or non-ferrous alloy and shall be mounted directly to the door with four (4) wood screws, machine screws, or, through bolted where required for positive attachment for wood fire rated doors.
- F. All exit devices for this project shall have the chassis, end cap, and horizontal mounting rail, mount directly to, and flush with, the door surface. No gaps or space shall be permitted between the back of the horizontal mounting rail and the door surface. If required, a continuous solid stainless steel or bronze dull chrome plated spacer bar shall be used to fill the space between the back of the devices and the door surface.
- G. The chassis cover shall be 16-gauge, cold formed stainless steel, fastened to the solid cast pressure formed chassis, by four (4) Phillip head machine screws, at the side of the chassis cover.
- H. The rail assembly shall be 14-gauge, heavy wrought stainless steel. The rail assembly shall consist of a stainless steel case with a 16-gauge, heavy wrought stainless steel touch pad with a Lexan touch pad protection plate.
- I. The end cap shall be a high impact resistant black lexan, fastened to the rail assembly by means of two, stainless steel Phillip head machine screws.
- J. The touch pad shall retract the latch bolt by means of a sliding motion of the touch pad towards the lock stile, activating the lever arm for easy operation and reduced friction.
- K. All exit devices, regardless of function, except for fire rated devices, shall have one-point cylinder dogging. The cylinder for cylinder dogging shall be a six (6) pin cylinder keyed to the building master key system as specified under Section, "Keying"
- L. Trim for exit devices shall be one of the following as specified:

1. Cast stainless steel lever handle with cast escutcheon.
2. Pull handles as specified in Section Push and Pull Bars.
- M. Devices for fire rated doors shall be listed for three (3) hour A label doors by Underwriters Laboratories in full compliance with NFPA 80 and 101. Exit devices with ratings of less than three (3) hours or listed with Laboratories other than Underwriters Laboratories shall not be considered acceptable for this project. Fire exit devices shall be installed only on fire doors bearing the marking, "Fire doors to be equipped with fire exit hardware".
- N. Where removable mullions are required, provide a fire rated U.L. listed mullions shall be provided for all pairs of doors requiring mullions whether the door carries a fire rating or not.
- O. Exit devices, as manufactured by Sargent & Company 88 Series, and Von Duprin Division 98, meeting all of the specification requirements set forth above, shall be considered acceptable for this project.
- P. Provide rim exit devices for single doors and mortise lock devices with open back strike and vertical rod devices for pairs of doors.
- Q. The following is a list of the functions referred to under hardware sets (1, 2, 3) and the model numbers of the acceptable manufacturers:

<u>TYPE</u>	<u>PRECISION</u>	<u>SARGENT</u>	<u>VON DUPRIN</u>
R-1 (Exit Only)	2101	8810	98EO
R-2 (Night Latch)	2103	8804	98NL
R-3 (Key Lock)	2108	8813	98L
R-4 (Passage)	2114	8815	98LBE

2.5 KEYING

- A. Provide cylinder housings to accept permanent cores conforming to the Owner's existing key system and following requirements:
 1. Provide construction cores with construction master keying for use during construction. The Owner or Owner's security agent shall install permanent keyed cores upon completion of the project. The temporary construction cores are to be returned to the hardware supplier.
 2. Provide permanent cores keyed by the factory to the Owner's requirements
 3. The hardware supplier, accompanied by a qualified factory representative for the manufacturer of the cores and cylinders, shall meet with Owner and Architect to review keying requirements and lock functions prior to ordering finish hardware.
 4. Provide keys as follows
 - a. Two keys per lock and/or cylinder.
 - b. Two construction core control keys
 - c. Six construction master keys for each type
 5. Deliver all keys and permanent cores from the factory or authorized distributor directly to the Owner in sealed containers, return receipt requested. Failure to comply with these requirements may be cause to require replacement of all or any part of the keying system that was compromised at no additional cost to the Owner.

2.6 DOOR CLOSERS

- A. All door closers for this project shall be the product of one manufacturer and shall have heavy cast cases with full cover and be full rack and pinion type construction, non-handed and non-sized with adjustable back-check effective at 70 degrees for both standard and parallel arm mounting.
- B. The closers shall meet or exceed the requirements of ANSI/BHMA A156.4, Grade 1.
- C. The following products will be acceptable:

<u>Manufacturer</u>	<u>Model</u>
Dorma	8900
LCN	4111/4011
Sargent	280

- D. At areas and routes accessible to persons with disabilities, provide closers that meet all state and federal regulations.
- E. The hardware contractor shall insert in the hardware schedule, beside each door listing, the required degree of opening for each door. If the door swing is over 140 degrees, parallel arm type closers shall be used. Door closers mounted on corner brackets, or top jamb application, shall not be permitted.
- F. Door closers with Cush-N-Stop arms shall be provided for all exterior, out-swing doors and other openings as specified under hardware sets. They shall have heavy forged steel parallel arms and soffit plates attached to the frame by six (6) screws. The forged steel arm shall have a positive stop bracket with an adjustable tension hold-open feature controlled with a slotted screw permitting adjustment from no hold-open to full restraint of door movement, Cush-N-Stop hold open function. The hold open feature does not apply to fire doors.
- G. Where door closers are noted to require delayed action feature, provide closers as specified herein, but having a separate delayed action valve, to permit adjustment of delayed action cycle. When adjusted, the door closer shall close at a controlled rate of speed, through the delayed action cycle range.
- H. The installing contractor shall be responsible for proper installation of door closers in accordance with degree of opening indicated on hardware schedule. Adjustment of all valves, for proper control of closing speed, latching speed, delayed action, back check, and spring power adjustments, shall be the responsibility of the installing contractor as set forth in Part III Execution.
- I. Where top rail of door is insufficient in height to mount the closer directly to the rail, drop brackets shall be provided.

2.7 DOOR STOPS

- A. It shall be the responsibility of the hardware supplier to provide door stops for all doors in accordance with the following requirements.
- B. Exterior doors striking masonry and other doors specified to have door stops and holders shall have cast bronze wall or floor type door stops holders with hook or staple to engage door and to selectively hold in open position. The following will be acceptable:

Ives	445, 446
Door Controls	3237X, 3347X
Rockwood	473, 477

2.8 SILENCERS

- A. Provide rubber silencers for all interior steel (hollow metal) frames. Silencers shall be pneumatic type 1/2-inch diameter with 1/8-inch projection.
- B. Provide 3 silencers for the strike jamb of steel frames for single doors and two for the head for steel frames for pairs of doors.

2.9 KICK PLATES

- A. Kick plates shall be .050-gauge solid stainless steel 8-inches (6-inches at full glass doors) high by 1- 1/2 inches less door width for single doors and 1 inch less door width for pairs of doors.
- B. Kick plates shall be applied on the push side of all doors for which kick plates are scheduled.

2.10 FLUSH BOLTS

- A. Extension flush bolts shall have forged bronze face plate with extruded brass lever and with wrought brass guide and strike. Rods for flush bolts shall be 12-inch steel or brass for doors up to 7'-6" in height. Where doors are over 7'-6" in height the flush bolt rod length shall be increased in increments of six (6) inch for each six (6) inch of additional door height. Plate size shall be 6 3/4-inch x one (1) inch to meet ANSI A115 and SDI specifications. Bolt projection shall be 5/8-inch.
- B. Floor strikes for flush bolts shall be dustproof type cast or extruded bronze with cast bronze floor plate minimum 3-1/2-inch x 1-5/8-inch with masonry anchors for concrete floors. Provide a dustproof strike, for sill application, for all bottom flush bolts for all pairs of doors.
- C. The following products will be acceptable:

Ives	458
Door Controls	780
Rockwood	555

2.11 THRESHOLDS

- A. General: Provide thresholds at all exterior doors and at other doors as indicated in the hardware schedule and on the drawings.
- B. Length: Full width of door opening.
- C. Anchorage: Anchor thresholds with no less than four (4) machine screw anchors for lengths 3'-0" and shorter. Provide an additional anchor for each 6" longer than 3'-0". Provide nonferrous solid brass or stainless steel screws.
- D. Saddle Thresholds: Extruded aluminum saddle thresholds shall have factory installed vinyl foot seals:
 - 1. NGP 427E
 - 2. Pemko 176
 - 3. Reese 427
 - 4. Or equal

2.12 WEATHER STRIPPING

- A. General: Provide weather stripping at all exterior doors and at other doors as indicated in the hardware schedule and on the drawings.
- B. At Rated Doors: Weather stripping (gasketing material) shall be classified by Underwriters Laboratories for application on fire door frames, for openings rated up to 3 hours.
- C. Finish: The finish for the exposed continuous aluminum weather stripping brackets, shall be natural anodized aluminum finish.
- D. Head and Jamb Weatherstripping (HM Doors): At all exterior hollow metal doors and at other hollow metal doors as indicated in the hardware schedule, provide an extruded aluminum perimeter seal with neoprene gasketing material (weather-stripping) for head and jambs. The neoprene seals shall be an airfoil design to permit full and positive closure between door and jamb. The continuous aluminum brackets shall be applied on the stop with stainless steel sheet metal screws at the corner of the rabbet located so as to provide full closure at the head and jamb perimeters. Where the door comes in contact with the frame, the maximum projection for the continuous aluminum weather stripping brackets shall be no more than ¼-inch:
 - 1. NGP 135NA
 - 2. Pemko 303APK
 - 3. Reese 678
 - 4. Or equal
- E. Astragal Weather Stripping:
 - 1. Doors with Active and Inactive Leafs: Astragal weather-stripping shall be a 1 5/8-inch overlapping aluminum astragal with a 3/8-inch thick neoprene strip seal:
 - a. NGP 109NA
 - b. Pemko 375R
 - c. Reese 93
 - d. Or equal
- F. Door Bottoms (HM Doors): Provide a door bottom at all hollow metal doors indicated to have weather stripping. The door bottom seal shall be concealed in the bottom of the door and shall be a flexible synthetic vinyl that will not take a formal set, nor break or flake in cold weather. The door bottom seal shall extend the full width of the door and shall also extend below the door bottom and compress against the top of the threshold, for complete closure. The door bottom seal shall be fastened to the recessed channel with 3 or 4 screws through the seal or the seal chassis. Concealed door bottoms must be installed before the door is in place:
 - 1. NGP 12V
 - 2. Pemko 208AV
 - 3. Reese DB591
 - 4. Or equal

2.13 FINISH

- A. With the exceptions of door closers, plates, coordinators, thresholds and weather stripping, all hardware items shall be furnished in satin stainless steel finish 32D.

B. Exceptions are as follows:

Door Closers:	Sprayed Aluminum
Thresholds:	Natural Anodized Aluminum
Weather stripping:	Natural Anodized Aluminum

PART 3 - EXECUTION

3.1 INSPECTION

- A. It shall be the General Contractor's responsibility to inspect all door openings and doors to determine that each door and door frame has been properly prepared for the required hardware. If errors in dimensions or preparation are encountered, they are to be corrected by the responsible parties prior to the installation of hardware.

3.2 PREPARATION

- A. All doors and frames, requiring field preparation for finish hardware shall be carefully mortised, drilled for pilot holes, or tapped for machine screws for all items of finish hardware in accordance with the manufacturer's templates and instructions.

3.3 INSTALLATION

- A. All materials shall be installed in a workmanlike manner following the manufacturer's recommended instructions.
- B. Exit devices shall be carefully installed so as to permit friction free operation of crossbar, touch bar, thumb latch, lever or knob. Latching mechanism shall also operate freely without friction or binding.
- C. Door closers shall be installed in accordance with the manufacturer's instructions. Each door closer shall be carefully installed, on each door, at the degree of opening indicated on the hardware schedule. Arm position shall be as shown on the instruction sheets and required by the finish hardware schedule.
- D. Installation of all other hardware, including locksets, push-pull latches, overhead holders, door stops, plates and other items, shall be carefully coordinated with the hardware schedule and the manufacturer's instruction sheets.
- E. Locations for finish hardware shall be in accordance with dimensions listed in the pamphlet "Recommended locations for Builders' Hardware" published by the Door and Hardware Institute.

3.4 FIELD QUALITY CONTROL

- A. Upon completion of the installation of the finish hardware, it shall be the responsibility of the finish hardware supplier to visit the project and to examine the hardware for each door on which they have provided hardware and to verify that all hardware is in proper working order. Should they find items of hardware not operating properly, they should make a report, in writing, to the general contractor, advising of the problem and the measures required to correct the problem.

3.5 ADJUSTING

- A. The adjustments for all door closers shall be the contractor's responsibility and these adjustments shall be made at the time of installation of the door closer. The closing speed and latching speed valves, shall be adjusted individually to provide a smooth, continuous closing action without slamming. The delayed action feature or back check valve shall also be adjusted so as to permit the corrected delayed action cycle or hydraulic back check cushioning of the door in the opening cycle. All valves must be properly adjusted at the time of installation.
- B. Each door closer has adjustable spring power capable of being adjusted, in the field, from size 2 through 6. It shall be the contractor's responsibility to adjust the spring power for each door closer in exact accordance with the spring power adjustment chart illustrated in the door closer installation sheet packed with each door closer.

3.6 CLEANING

- A. It shall be the responsibility of the general contractor to clean all items of finish hardware and to remove any remaining pieces of protective materials and labels.

3.7 PROTECTION

- A. All exposed portions of finish hardware shall be carefully protected, by use of cloth, adhesive backed paper or other materials, immediately after installation of the hardware item on the door. The finish shall remain protected until completion of the project. Prior to acceptance of the project by the engineer and owner, the general

contractor shall remove the protective material exposing the hardware finish.

3.8 INSTRUCTIONS AND TOOLS

- A. It shall be the responsibility of the finish hardware supplier to provide installation and repair manuals and adjusting tools, wrenches, etc., for the following operating products:
1. Locksets (all types)
 2. Exit devices (all types)
 3. Door closers

3.9 HARDWARE SET NUMBERS

- A. The Hardware Sets listed below indicate the items of hardware required for each opening. It is the bidder's responsibility to accurately furnish the proper quantities, items, sizes, weights and functions as required by the plans and this specification. If an opening has, through error, been omitted from the following hardware set numbers listings, it shall be the bidders responsibility to supply hardware of equivalent quality and quantity, as that which is specified for a comparable opening.

HDWR# 1 (typical exterior door with lockset)

Each leaf shall have: Hinges, Lockset Function D, Closer with Cush-n-Stop, Kickplate, Weather-stripping, Threshold.

HDWR# 2 (typical exterior door with panic device)

Each leaf shall have: Hinges, Exit Device R-3, Closer with Cush-n-Stop, Kickplate, Weather-stripping, Threshold.

HDWR# 3 (typical exterior double doors)

Each leaf shall have: Hinges, Closer with Cush-n-Stop/Hold Open Function, Kickplate, Weather-stripping, Threshold.

Active Leaf: Exit Device R-3, Astragal Weather-stripping.

Inactive Leaf: Flush Bolts, provide 7/8" lip strike.

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and field painting of the following surfaces of new items unless specified elsewhere to be prefinished. This includes pre-primed surfaces.
 - 1. Painting of all submerged surfaces.
 - 2. Painting of all exposed interior surfaces.
 - 3. Painting of all exposed exterior surfaces.
- B. Painting of existing items:
 - 1. Existing floors, walls and ceilings to receive surface preparation and field painting are indicated on the drawings and in the specifications.
 - a. All previously painted items located within floors, walls and ceilings indicated to be painted will also receive surface preparation and field painting.
 - 2. Any other existing items on the drawings or in this specification indicated to be painted will receive surface preparation and field painting.
- C. This Section also includes:
 - 1. Piping runs above finished ceilings shall be considered exposed and shall be painted.
 - 2. Back prime, with specified interior first coat, all surfaces of wood finish and trim which will be concealed after installation.
 - 3. All surfaces of ferrous metal fabrications built into concrete and masonry shall be shop primed or receive a primer coat in accordance with this section. All surfaces exposed to view shall receive intermediate and finish coats.
 - 4. Pipe, pump and valve identification markers.
 - 5. Skid resistant floor coating where shown on the Drawings.
 - 6. Secondary containment coatings.
 - 7. Motors and equipment which are pre-finished shall receive one top coat to provide a color matching the system color indicated in the pipe identification schedule.
 - 8. Load rating identification markings for monorails and lifting hooks.
 - 9. Paint all items modified or relocated in the existing facility.
- D. Definitions:
 - 1. Submerged surfaces are defined as:
 - a. Those surfaces which are below the maximum water surface level as indicated on the drawings, and/or extend 3-feet above the maximum water surface for uncovered tanks.
 - b. All surfaces contained within covered tanks.
 - c. The full height of all partially submerged items such as sluice, slide and weir gates, piping, etc.

- d. All surfaces contained within underground vaults, structures and manholes such as valve pits, dry wells, etc.
- 2. Exposed interior surfaces shall be non-submerged surfaces exposed to view that are enclosed and/or protected in such a manner that they cannot be exposed to UV light or weather conditions.
- 3. Exposed exterior items shall be all other surfaces which don't fall under the definition of "submerged" or "exposed interior surfaces".
- E. Items not requiring surface preparation and field painting:
 - 1. Items and equipment that are specifically specified to receive the manufacturer's standard primer and finish coats in the factory, except as noted for color and touch-up painting.
 - 2. Copper, bronze, brass, chromium plate, nickel, stainless steel, aluminum or monel metals (unless otherwise noted).
 - 3. Unprimed galvanized metals not indicated to be painted shall remain unfinished.
 - 4. Concrete slabs and walls unless indicated in the finish schedule on the drawings to be painted or receive secondary containment coatings.

1.2 REFERENCES

- A. ASTM D2247 - Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity.
- B. ASTM D 2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- C. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- D. D ASTM D6386 - Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Products for Painting
- E. Federal Test Method No. 141 - Method 6141, Stain Removal.
- F. ANSI A13.1 - Scheme for the Identification of Piping Systems.
- G. SSPC - Steel Structures Painting Council.
- H. SSPC-PA1, "Standard for Shop, Field, and Maintenance Painting."
- I. SSPC-PA2, "Measurement of Dry Paint Thickness with Magnetic Gauges."
- J. SSPC-SP1, "Solvent Cleaning."
- K. SSPC-SP2, "Hand Tool Cleaning."
- L. SSPC-SP3, "Power Tool Cleaning."
- M. SSPC-SP6, "Commercial Blast Cleaning."
- N. SSPC-SP7, "Brush Off Blast."
- O. SSPC-SP10, "Near-White Blast Cleaning."
- P. SSPC-SP16, "Brush Blast Cleaning of Non Ferrous Metals"
- Q. SSPC-PA Guide 3, Standard "A Guide to Safety in Paint Application," latest revision.
- R. VOC Standards - All coatings shall be in accordance with all applicable State and Federal VOC Standards.
 - 1. OSHA 29 CFR 1925.55 Gases, Vapors, Fumes, Dusts and Mists.
 - 2. Ozone Transportation Commission (OTC) 2005 VOC Regulation.
 - 3. 38 MRSA: Section 584A; Air Protection and Improvement Law.
- S. OSHA 29 CFR 1926.62 Lead.

- T. SSPC - Guide 61 (COH) Guide for Containing Debris Generated during Paint Removal Operations.
- U. SSPC - Guide 71 (DIS) Guide for Disposal of Lead-Contaminated Surface Preparation Debris.
- V. SSPC Publication 91-18 Industrial Lead Paint Removal Handbook.
- W. USEPA 40 CFR Part 261 Identification and Listing of Hazardous Waste.
- X. USEPA 40 CFR Part 262 Standards Applicable to Generators of Hazardous Waste.
- Y. USEPA 40 CFR Part 263 Standards Applicable to Transporters of Hazardous Waste.
- Z. USEPA 40 CFR Part 268 Land Disposal Restrictions.
- AA. USDOT 49 CFR Parts 173, 178 and 179.

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 01340 including tested performance characteristics.
- B. Submit manufacturer's color chips showing the full range of colors available for each type of finish coat material specified.
- C. Submit schedule on manufacturer's letter head with list of items to be coated, type and manufacturer of shop coating and type of field coating, including primers, details on surface preparation methods, application procedures and dry mil thickness.
- D. Submit a letter from the manufacturer certifying that the products submitted are applicable for the applications indicated.
- E. Submit coating manufacturer's certification that the proposed coatings meet all state and federal VOC regulations.

1.4 QUALITY ASSURANCE

- A. The Contractor shall obtain the services of a painting contractor with 5 years' experience on similar projects.
- B. All materials used on work shall be exactly as specified in brand and quality. No claim by the Contractor as to unsuitability or unavailability of any material specified, or their unwillingness to use same, or their inability to produce first class work with same, will be entertained unless such claims are made in writing and submitted to the Engineer at least seven (7) days prior to the date established for receipt of General Bids.
- C. Before purchasing materials for the work, the Contractor shall submit to the Engineer a list of the products they propose to use, and the list shall be reviewed by the Engineer and no exceptions taken before commitment for materials is made.
- D. Materials selected for coating systems for each type of surface shall be the products of a single manufacturer.
- E. Include on label of all containers:
 - 1. Manufacturer's name
 - 2. Type of paint
 - 3. Manufacturer's stock number
 - 4. Color
 - 5. Instructions for reducing, where applicable
 - 6. Label analysis
 - 7. Shelf life dates

- F. Field Quality Control:
1. Contractor shall request review by the Engineer, of first finished room, space or item of each color, texture and method of applications, prior to proceeding with additional painting.
 2. Use first acceptable room, space or item as the project standard for each color scheme.
 3. For spray application, when applicable, paint a surface not smaller than 100 square feet as the project standard.
 4. Repainting of materials failing to meet the requirements of the Specifications or Drawings, shall be performed by the Contractor, at no additional cost to the Owner.
 5. The number of coats and total mil thickness specified in the paint schedule are minimums. If the specified minimum film thickness is not achieved, additional coats shall be applied to achieve the total film thickness specified.
- G. Paints submitted shall meet all Federal and State regulations pertaining to Volatile Organic Compounds (VOC) compliance and be in accordance with OTC 2005 Standards.
- H. All coating systems used for potable water applications shall be previously approved by the National Sanitation Foundation (NSF) in accordance with Standard 61. Evidence of compliance shall be an approval letter from NSF listing the submitted material.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver coating materials in sealed containers with labels legible and intact.
- B. Store only acceptable project materials on the project site.
- C. All painting materials shall be stored and mixed in a single location coordinated with the Engineer. The Contractor shall not use any plumbing fixture or pipe for mixing or for disposal of any refuse. The Contractor shall carry all necessary water to the mixing room and shall dispose of all waste outside of the building in a suitable receptacle.
- D. Restrict storage location to paint materials and related equipment and supplies.
- E. Keep storage location neat and clean.
- F. Remove all soiled and used rags, waste and trash from the storage location and building at the end of each work day.
- G. Repair all damage to the storage location, caused by painting materials and equipment at no additional cost to the Owner.
- H. Comply with all applicable health and fire codes and regulations including safety precautions recommended by the manufacturer. Storage space shall be provided with a suitable fire extinguisher fully charged at all times.
- I. Heat shall be provided in the storage area if paints are to be stored during winter months. The temperature shall be maintained above 40 degrees F at all times.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems shall be applied.
- B. Do not apply coatings in areas where dust is being generated.

- C. Do not apply coatings when the air or material surface temperature is below 50 degrees Fahrenheit and unless the temperature is at least 5 degrees Fahrenheit above the dew point.
- D. Do not apply exterior coatings in frosty, damp or rainy weather or while surfaces are exposed to hot sunlight.

1.7 EXTRA MATERIALS

- A. For all materials with a shelf life of greater than 12 months, provide one gallon of each type and each color of touch-up paint shall be provided to the Owner by the Contractor in unopened containers.

PART 2 - PRODUCTS

2.3 MANUFACTURERS

- A. Tnemec Company, Inc.
- B. Sherwin Williams
- C. PPG

2.4 MATERIALS

- A. Refer to the paint schedule for specific products and application.

2.5 COMPONENTS

- A. All finish coats shall be compatible with shop prime coats.
- B. Turpentine shall be pure spirits of turpentine.
- C. Shellac shall be four pounds and shall meet the U.S. Government specifications as issued by the Bureau of Commerce.
- D. When metal are primed in the mill or shop as part of painting contract, use the materials specified in every case for such surfaces and use in accordance with manufacturer's directions for first or priming coat.

2.6 MIXING AND TINTING

- A. Deliver paints and enamels ready-mixed to project site.
- B. Accomplish job mixing and job tinting only when required.
- C. Mix only in mixing pails placed in suitably sized nonferrous or oxide resistant metal pans.
- D. Use only tinting colors recommended by the manufacturer for the specific type of finish.
- E. Fungicidal agents, when applicable, shall be incorporated into the paints and stains by the manufacturer.
- F. Mix and prepare paints in strict accordance with Manufacturers recommendations.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence or quality of work and which cannot be put into an acceptable condition through preparatory work as included in Part 3.2, Surface Preparation.
- B. Immediately notify the Engineer in writing when a surface to be finished cannot be put into an acceptable condition.
- C. Do not proceed with surface preparation or coating application until conditions are suitable.
- D. The Contractor shall be responsible for and shall rectify, at no additional cost to the Owner any unsatisfactory finish resulting from the application of coatings on surfaces not in acceptable condition.

3.2 SURFACE PREPARATION

- A. At a minimum, all surfaces must be prepared and cleaned in accordance with the manufactures written specifications and pertaining to the intended substrate to be coated. The contractor must be fully read and understand all of these requirements and all other required product recommendations prior to commencing any work.
- B. Wood and Plywood to be Painted or Finished Natural:
 - 1. Clean soiled surfaces.
 - 2. Except when rough surface is specified, sand to smooth and even surface, then dust off.
 - 3. Apply shellac to all knots, pitch and resinous sapwood after washing with mineral spirits and, before priming coat is applied.
 - 4. Fill nail holes, cracks, open joints and other defects with paste wood filler before priming coat surface and color to match finish color. When wood filler is applied on open grain wood, allow the grain to secure a smooth, clean surface.
 - 5. Tint filler to match finished wood to be stained.
- C. Concrete and Masonry:
 - 1. Clean all dust, dirt, oil and efflorescence from surfaces.
 - 2. Fill cracks and irregularities with Portland cement grout to provide uniform surface texture.

3. Etch dense and smooth concrete, or concrete that has had a hardener applied, with a five percent solution (by weight) of muriatic acid.
 4. Fill concrete masonry unit surfaces with block filler in sufficient thickness to produce a final result which shall fill all voids and pin holes.
 5. Allow surfaces to thoroughly dry prior to application of first coat.
- D. Ferrous Metal Surfaces (Items not shop primed):
1. All submerged ferrous metals shall be sandblast cleaned in accordance to SSPC-SP10 immediately prior to priming.
 2. All other ferrous metals shall be sandblast cleaned in accordance to SSPC-SP6 immediately prior to priming.
 3. Remove dirt, oil and grease by washing surfaces with mineral spirits.
 4. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.
 5. Feather edges of sound existing paint by grinding, if necessary.
 6. Clean and touch up weathered, worn or damaged shop coats of paint with the specified primer.
 7. Restore shop coats of paint with identical materials if removed for welding and fabrication.
- E. Galvanized metals indicated to be painted (nonferrous metals):
1. Solvent clean in accordance with ASTM D6386.
 2. Surfaces shall receive SSPC-SP-16 and shall be surfaced prepared in accordance with ASTM D6386.
 3. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.
 4. Restore shop coats of paint with identical materials if removed for welding and fabrication.
- F. Previously Coated Surfaces (including existing items and new items that are shop primed):
1. The areas of the coated surface that are blistered, eroded, brittle or otherwise failed shall be completely removed before beginning the specified surface preparation.
 2. The areas where the existing coating is intact shall be sanded to dull the finish.
 3. Before applying the new coating over an existing coating, a test section must be done to ensure compatibility of the new and old coatings.
 4. All other existing coatings shall be prepared as recommended by the manufacturer and as specified in this section.
 5. Ferrous metals arriving at the job site with shop primers other than the polyamide epoxy or rust inhibitive primers specified shall be provided with an intermediate coat as necessary for compatibility with specified topcoats.
 6. Special attention shall be paid to the potential for epoxy shop and intermediate coats to chalk upon exposure to sunlight. The Contractor shall follow the manufacturer's required surface protection/covering and surface preparation recommendations before any intermediate or top coats can be applied over chalked surface. Epoxy primers and intermediate coats shall be top coated no later than 45 days after the application of the epoxy coating. If topcoats are to be applied later than 45 days, the following surface preparation shall be provided:

- a. The existing finish shall be etched by sanding with 80 grit paper or cloth.
 - b. Surfaces shall be pressure washed with 3000 to 5000 pounds of pressure.
 - c. The Engineer, at its discretion, can require the Contractor to conduct adhesion tests of the topcoats.
7. The following shall be the minimum surface preparatory for existing surfaces that are to be painted, unless indicated otherwise:
- a. Existing submerged ferrous metals.
 - Clean
 - Sandblast in accordance with SSPC-SP10.
 - b. Non-submerged ferrous metals.
 - Clean
 - Sandblast in accordance with SSPC-SP6.
 - c. Existing concrete floors and all surfaces to receive secondary contaminant coatings.
 - Clean
 - Sand or shot blast to remove existing coatings and to provide an anchor profile for the new coating.
 - d. Existing Concrete and Masonry
 - Clean
 - Scrape existing paint to a sound surface.
 - Sand with 80 grit paper or cloth to provide anchor profile for new coating.
 - Pressure wash all existing epoxy coated surfaces.

3.3 APPLICATION

- A. Workmanship:
1. Employ skilled workmen to ensure workmanship of the highest quality.
 2. Materials shall be applied only by craftsmen experienced in the use of the specific products involved.
- B. General Requirements:
1. Apply all coatings under adequate illumination.
 2. Perform no work in the rain, dew, or fog, when the temperature is below 50 degrees Fahrenheit and at least 5 degrees Fahrenheit above the dew point, or before the other coats have thoroughly dried.
 3. Do not apply coatings until the material surfaces are thoroughly dry.
 4. Apply paints with suitable brushes, rollers or spraying equipment.
 - a. The rate of application shall not exceed that as recommended by the paint manufacturer for the surface involved.
 - b. Keep brushes, rollers and spraying equipment clean, dry and free from contaminates and suitable for the finish required.
 - c. Make each coat a different tint from that of the preceding coat, with final coat tinted to the exact shade selected by the Engineer. Lightly sand surfaces between each coat of gloss and semi-gloss finishes, and wipe clean.
 5. Comply with the recommendation of the product manufacturer for drying time between succeeding coats. Contractor shall follow the manufacturer's specific

curing requirements for rust inhibitive primer shop coats prior to allowing topcoating.

6. Sand and dust between each coat to remove defects visible from a distance of five feet.
7. Finish coats shall be smooth, free of brush marks, streaks, laps or pile up of paints and skipped or missed areas.
8. Inspection:
 - a. Do not apply additional coats until the completed coat has been inspected by the Engineer.
 - b. Only inspected and reviewed coats will be considered in determining the number of coats applied.
9. Leave all parts of moldings and ornaments clean and true to details with no undue amount of paint in corners and depressions.
10. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.
11. Apply primer on all work before glazing.
12. Refinish entire wall where portion of finish has been damaged or is not acceptable.
13. Runs on face are not permitted.

3.4 PROTECTION

- A. Furnish and lay drop cloths in all rooms and areas where painting and finishing is being done to adequately protect flooring and other work from damage during the prosecution of the painting work.
- B. Remove all canopies of lighting fixtures, all electric switch plates, and similar equipment, set them carefully away, and cover adequately, protect the fixtures, etc.; replace the canopies, plate, etc. in as good condition as when found.
- C. Do not paint over any code-required labels, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.
- D. Correct and refinish all interior and exterior surfaces in the existing facility affected by the new work. Materials and their application shall be as required to most closely match the existing finishes and as specified in this Section.

3.5 CLEANING

- A. At the completion of the work of this Section, remove all paint spots and oil or grease stains, caused by this work from floors, walls, fixtures, hardware and equipment, leaving their finishes in a satisfactory condition. Remove all materials and debris and leave the site of the work in a clean condition so far as this work is concerned.

3.6 FINAL INSPECTION

- A. Protect all painted and finished surfaces against damage until the date of final acceptance of the work. The Engineer will conduct a final inspection of all painters' work. As part of the final inspection the Contractor shall demonstrate compliance with the specified film thickness with appropriate paint gauges. The Contractor shall

be required to repaint, refinish, or retouch any areas found which do not comply with the requirements of this Section.

3.7 LOAD RATING IDENTIFICATIONS

- A. Provide markings indicating the load rating of all hoists, monorails and lifting hooks.
- B. Markings shall be 3-inches high stenciled letters painted adjacent to the item in a color contrasting the background color.

3.8 PAINT SCHEDULE

- A. The following product model and coatings system numbers are listed below to establish the standard of quality. Equivalent products from other manufactures will be accepted provided they meet or exceed the performance of the listed products.
- B. The primer coat is not required on shop primed items. Installer to verify that proposed field coatings are compatible with shop coatings.

SURFACE/ITEM	SURFACE PREPARATION	PRIMER	INTERMEDIATE	FINISH
PLASTER & DRYWALL				
Drywall Surfaces	Clean & Dry	Tnemec Series 51 PVA Sealer OR SW Promar 200 Zero VOC Latex Primer at 1.0 to 2.5 mils	Tnemec Series 1028/1029 Enduratone at 2 to 3 mils OR SW Pro Industrial Acrylic Coating at 3 to 4 mils	Tnemec Series 1028/1029 Enduratone at 2 to 3 mils OR SW Pro Industrial Acrylic Coating at 3 to 4 mils
MASONRY & CONCRETE				
Non-Submerged Concrete Vertical and Ceiling Surfaces	Clean, Dry and Surface Grind	Tnemec 151-1051 Elasto Grip FC at 2 to 3 mils mils OR SW Loxon Conditioner Primer at proper DTF	Tnemec Series 1028/1029 Enduratone at 2 to 3 mils OR SW Pro Industrial Acrylic Coating at 3 to 4 mils	Tnemec Series 1028/1029 Enduratone at 2 to 3 mils OR SW Pro Industrial Acrylic Coating at 3 to 4 mils
METALS				
Submerged Ferrous Metals in contact with sewer water, higher H2S exposures	SSPC-SP10 Near White Metal Blast Cleaning	Tnemec Series N69 Tneme- Epoxoline 11 at 3 to 5 mils OR SW Sher-Glass FF Epoxy at 8 to 10 mils	Tnemec Series N69 Tneme- Epoxoline 11 at 3 to 5 mils OR SW N/A	Tnemec Series N69 Tneme- Epoxoline 11 at 3 to 5 mils OR SW Sher-Glass FF Epoxy at 8 to 10 mils
Submerged Ferrous Metals in contact with sewer water, lower H2S exposures	SSPC-SP10 Near White Metal Blast Cleaning	Tnemec Series N69 Tneme- Epoxoline 11 at 3 to 5 mils OR SW Macropoxy 646 at 5 to 6 mils	Tnemec Series N69 Tneme- Epoxoline 11 at 3 to 5 mils OR SW Macropoxy 646 at 5 to 6 mils	Tnemec Series N69 Tneme- Epoxoline 11 at 3 to 5 mils OR SW Macropoxy 646 at 5 to 6 mils

SURFACE/ITEM	SURFACE PREPARATION	PRIMER	INTERMEDIATE	FINISH
Weather Exposed Ferrous Metal Piping and Equipment	Per Manufacturer's Specifications	Tnemec Series N69 Tneme-Epoxoline 11 at 3 to 5 mils OR SW Macropoxy 646 at 5 to 6 mils	Tnemec Series 73 Endura-shield at 3 to 4 mils OR SW Acrolon 218 HS Acrylic Polyurethane at 3 to 4 mils	Tnemec Series 73 Endura-shield at 3 to 4 mils OR SW Acrolon 218 HS Acrylic Polyurethane at 3 to 4 mils
Enclosed Ferrous Metal Piping and Equipment	Per Manufacturer's Specifications	Tnemec Series N69 Tneme-Epoxoline 11 at 3 to 5 mils OR SW Macropoxy 646 at 5 to 6 mils	Tnemec Series N69 Tneme-Epoxoline 11 at 3 to 5 mils OR SW Macropoxy 646 at 5 to 6 mils	Tnemec Series N69 Tneme-Epoxoline 11 at 3 to 5 mils OR SW Macropoxy 646 at 5 to 6 mils
All Other Weather Exposed and Enclosed Ferrous Metals	Per Manufacturer's Specifications	Tnemec Series 1 Omnithane Gray at 2.5 to 3 mils OR SW-Kem-Bond HS Universal Primer at 3 mils	Tnemec Series 1028/1029 Enduratone at 2 to 3 mils OR SW Pro Industrial Acrylic Coating at 3 to 4 mils	Tnemec Series 1028/1029 Enduratone at 2 to 3 mils OR SW Pro Industrial Acrylic Coating at 3 to 4 mils
Galvanized metal fabrications built into concrete and masonry including lintels.	ASTM D6386 Solvent Cleaning Followed by SSPC-SP16	Tnemec Series 1 Omnithane Gray at 2.5 to 3 mils 3 mils OR SW Recoatable Epoxy Primer at 4 to 6 mils	Top coats as noted herein for the surfaces exposed to view	Top coats as noted herein for the surfaces exposed to view
Exposed electrical conduit, conduit fittings and outlet boxes mounted on painted or finished surfaces or exposed in painted rooms		Same color and finish as background surface and/or equipment	Same color and finish as background surface and/or equipment	Same color and finish as background surface and/or equipment
WOOD & CARPENTRY				
Exterior Wood Siding and Trim			Sherwin Williams WoodScapes Solid Color Acrylic Stain A15 Series OR Sherwin Williams WoodScapes Semi-Transparent Polyurethane Stain A15T5 Series	Sherwin Williams WoodScapes Solid Color Acrylic Stain A15 Series OR Sherwin Williams WoodScapes Semi-Transparent Polyurethane Stain A15T5 Series
PVC Trim	As recommended by the product manufacturer.			

SURFACE/ITEM	SURFACE PREPARATION	PRIMER	INTERMEDIATE	FINISH
PIPING (other than ferrous metal)				
Insulated Pipe	Clean & Dry	Tnemec 151-1051 Elasto Grip FC at 2 to 3 mils OR SW Promar 200 Zero VOC Latex Primer at 1.0 to 2.5 mils	Tnemec Series 1028/1029 Enduratone at 2 to 3 mils OR SW Pro Industrial Acrylic Coating at 3 to 4 mils	Tnemec Series 1028/1029 Enduratone at 2 to 3 mils OR SW Pro Industrial Acrylic Coating at 3 to 4 mils
PVC Pipe	Clean & Dry - Scuffed Up with Medium Grit Sandpaper	Tnemec Series N69 Tneme-Epoxoline 11 at 3 to 5 mils OR SW Extreme Bond Bonding Primer at 2 to 5 mils	N/A	Tnemec Series N69 Tneme-Epoxoline 11 at 3 to 5 mils OR SW Pro Industrial Acrylic Coating at 3 to 4 mils

NOTES:

1. Surface preparation shall be as specified within this section and as noted in the table above.
2. All dry film thickness indicated are the minimum required.
3. All ferrous metals, piping and equipment delivered to the site with shop primers other than the specified primer shall receive an intermediate coat as necessary for compatibility with the indicated top coats.
4. The hollow metal doors and frames shall receive the primer indicated above, applied over the manufacturer's shop coatings.
5. Painting of the piping system shall include all ferrous valves, levers, valve handles, fittings, stands, supports, hangers, pumps and appurtenances.
6. Paint motors for color coordination.
7. Epoxy primers and intermediate coats that have been in place for more than 45 days shall be prepared as indicated under the "Surface Preparation" Section of this Specification.
8. Verify the products provided are compatible with the existing coatings in the existing facility.
9. Conduit Painting Schedule:
Electrical Rooms - Not painted
All other Rooms - Painted
Above Finish Ceiling - Not painted

3.9 PIPING IDENTIFICATION SCHEDULE

A. Pipe Coating

1. All pipes, whether concealed or exposed to view shall be painted a separate color as scheduled in the PIPE IDENTIFICATION SCHEDULE below or as otherwise directed by the Engineer. For insulated pipes, only the insulation shall be painted.
2. Pipe supports consisting of pipe rings, clamps, clevises, U bolts, pipe rollers, saddles, etc., shall be painted with the same color as that of the pipe.
3. Wall supported pipe hangers consisting of brackets, standoffs, etc., shall be painted with the same color as that of the wall.

4. Ceiling/roof supported pipe hangers consisting of thread rods, beam clamps, etc., shall be painted with the same color as that of the ceiling.
5. Floor supported pipes consisting of stanchions shall be painted with same color as that of the pipe.

B. Pipe Markers

1. Markers shall be corrosion resistant laminated plastic bound to the pipes with nylon fasteners or shall be "coil-fit." Stickers are not acceptable. Markers and flow direction indicators shall be manufactured by Seton, Brimar Industries, or equivalent.
2. Pipes with diameters less than 1-1/4 inch shall have marker hung from pipe with nylon fasteners.
3. Lettering size shall be in accordance with the following:

SIZE OF LEGEND LETTERS		
Outside Diameter of Pipe or Covering	Minimum Length of Marker	Size of Letters
In	In	In
Up to 1-1/4	8	1/2
1-1/2 to 2	8	3/4
2-1/2 to 6	12	1-1/4
8 to 10	24	2-1/2
Over 10	32	3-1/2

4. Adjacent to each marker there shall be an arrow indicating flow direction.
5. Marker location shall be in accordance with the American National Standard Institute Scheme for Identification of Piping Systems (ANSI A13.1). Markers shall be placed adjacent to all valves and/or flanges; adjacent to all changes in direction on all pipe branches; and where all pipes pass through walls or floors on each side of wall/floor. On straight runs of piping, markers shall be placed at no less than 10 foot intervals. Where pipes are located above or below the normal line of vision, the lettering shall be placed below or above (as appropriate) the horizontal centerline of the pipe.

C. Valve Status Indication Arrows

1. Valve status indicator alignment arrows shall be provided on the indicator and scale sides of all interior hand wheel, chain and lever operated valves. Arrow heads shall appear aligned when the valve is in the full-open position. Arrow heads shall be painted on with stencils, or a color contrasting with the color of the valve. Arrow heads shall be minimum of 3/4-inch in smallest dimension. Valve position indicators shall be aligned to be visible from normal working levels.

- D. Refer to Specification Sections 11000, 15100, 15400 and 15600 for Equipment and Valve Identification requirements.

PIPE IDENTIFICATION SCHEDULE

SYSTEM NAME/ MARKING	TAG	PIPE COLOR ⁽¹⁾	PIPE MARKERS ⁽²⁾
Water			
Cold Potable Water	CW	Lt. Blue	White on Green
Hot Potable Water	HW	Lt. Blue	White on Green
Heating Water Supply	HWS	Safety Blue w/ Red Bands	White on Green
Heating Water Return	HWR	Safety Blue w/ Red Bands	White on Green
Process Water	PRW	Blue w/ Black Band	White on Green
Drains			
Drains	D	Lt. Gray ANSI No. 70	White on Green
Process Liquid - Wastewater			
Force main	FM	Dark Gray	White on Green
Gases			
Natural Gas	NG	Safety Orange w/ Black Bands	White on Brown

- (1) Stainless steel piping shall not be painted, but shall receive the pipe markings indicated.
 (2) Pipe markers colors notations are defined as follows (ANSI/ASME A13.1-2015):
 White on Brown = White lettering on Brown background (combustible fluids)
 White on Green = White lettering on Green background (potable, cooling, boiler and other waters)

END OF SECTION

SECTION 09905SHOP COATINGSPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Surface preparation and application of shop coatings on materials, equipment, and piping indicated in the various specification sections relating thereto, and as specified herein, including primers and topcoats for materials, equipment and piping that are finished at the point of manufacturer or fabrication.
- B. Examine the various Sections of the Specifications and be thoroughly familiar with all provisions regarding shop coatings.

1.2 PREFINISHED ITEMS NOT REQUIRING PAINT OR FINISH

- A. Copper, bronze, brass, chromium plate, nickel, stainless steel, aluminum or monel metals, except surfaces in contact with or embedded within concrete or masonry, unless otherwise specified elsewhere.

1.3 REFERENCES

- A. ASTM D2247 - Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity.
- B. ASTM D 2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- C. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- D. Federal Test Method No. 141 - Method 6141, Stain Removal.
- E. SSPC - Steel Structures Painting Council.
- F. SSPC-PA1, "Standard for Shop, Field, and Maintenance Painting".
- G. SSPC-PA2, "Measurement of Dry Paint Thickness with Magnetic Gauges".
- H. SSPC-SP1, "Solvent Cleaning".
- I. SSPC-SP6, "Commercial Blast Cleaning".
- J. SSPC-SP10, "Near-White Blast Cleaning".
- K. SSPC-SP16, "Brush Blast Cleaning of Non Ferrous Metals"
- L. SSPC-PA Guide 3, Standard "A Guide to Safety in Paint Application", latest revision.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 01340.
- B. As a minimum, the following shall be included in the submittal package for all items, products, material or equipment, as specified.
 - 1. Submit data on the proposed shop coatings, details on surface preparation methods, application procedures and dry mil thickness.
 - 2. Submit a minimum of three (3) color charts for all factory top coats for color selection by Engineer.
 - 3. Submit coating manufacturer's certification that proposed shop coatings are compatible with field coatings, as specified in Section 09900.

1.5 QUALITY ASSURANCE

- A. All Shop Coatings shall meet the requirements of the materials section and shall be guaranteed by the manufacturer to be compatible with the field coatings, as specified in Section 09900. The Contractor shall coordinate this requirement during the Shop Drawing Phase.
- B. All Shop Coatings shall meet all Federal and State regulations pertaining to Volatile Organic Compounds (VOC) compliance.
- C. All Shop coatings used for potable water applications shall be certified by the National Sanitation Foundation (NSF) in accordance with Standard 61. Evidence of compliance shall be a letter from NSF listing the submitted material.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Refer to Part 3 - EXECUTION for specific products and applications.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Definitions
 - 1. Submerged surfaces are defined as:
 - a. Those surfaces which are below the maximum water surface level as indicated on the drawings, and/or extend 3'-0" above the maximum water surface for uncovered tanks.
 - b. All surfaces contained within covered tanks.
 - c. The full height of all partially submerged items such as sluice gates, slide gates, weir gates, piping, etc.
 - d. All surfaces contained within underground structures, vaults and manholes such as valve pits, drywells, etc.
 - 2. Enclosed surfaces are those non-submerged surfaces enclosed and/or protected within a building in such a manner that it cannot be exposed to UV light or weather conditions.
 - 3. Weather exposed surfaces are all other conditions including buried items which do not fall into the definition of submerged or enclosed surfaces, as noted above.
- B. Ferrous Metal
 - 1. All submerged ferrous metals shall be sandblast cleaned in accordance to SSPC-SP10, near white, immediately prior to priming.
 - 2. All other ferrous metals, Enclosed and Weather exposed surfaces, shall be sandblast cleaned in accordance to SSPC-SP6, commercial grade, immediately prior to priming.
 - 3. Remove dirt, oil and grease by washing surfaces with mineral spirits.
 - 4. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.
- C. Galvanized Metal (nonferrous metals indicated to be painted):
 - 1. Solvent clean in accordance with ASTM D6386.
 - 2. Surfaces shall receive SSPC-SP-16 and shall be surfaced prepared in accordance with ASTM D6386.

3. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.
4. Restore shop coats of paint with identical materials if removed for welding and fabrication.

3.2 APPLICATION

A. Equipment

1. Motors, speed reducers and similar parts shall have a surface preparation in accordance with the manufacturer standard coating requirements and suitable for weather exposed use. The minimum coating system shall be 3 coats of polyamide epoxy at a minimum of 3 mils per coat. Other coatings must be approved by the Engineer.
2. Items finished at the point of manufacture (shop primed and painted), such as submersible pumps and other similar surfaces, shall receive manufacturer's standard coating of baked, powder epoxy enamel, suitable for the intended service.
3. All equipment casing openings requiring protection shall have a water repellent tape and vapor phase inhibitor treated paper.
4. All other ferrous surfaces shall be factory primed in accordance with Section 3.2.C, except ferrous surfaces obviously not to be painted (such as gears, exposed machined or bearing surfaces, enclosed machined or bearing surfaces, lubricated contact surfaces moving under load, thread connections to be field connected and other similar items) which shall be given a heavy shop coat of grease or other suitable rust resistant coating per manufacturer's recommendations.
5. These coating shall be maintained as necessary to prevent corrosion during all periods of storage and erection, until final acceptance by the Owner.

B. Pipe, Fittings and Valves

1. The following surfaces shall be prepared in accordance with the manufacturer's recommendations and shall receive a shop coat of asphaltum varnish meeting Federal Specifications TT-C-494A or fusion bonded epoxy coating.
 - a) Interior surfaces of all hydrants, ductile iron pipe, fittings and valves except for air piping lines and air valves which shall be completely unlined.
 - b) The exterior surfaces of buried valves and miscellaneous piping appurtenances.
2. The exterior surfaces of all ductile iron pipe and fittings buried shall receive the standard factory applied asphaltic coating (in accordance with AWWA C151).
3. The exterior surfaces of ductile iron pipe, fittings and valves submerged, enclosed or weather exposed shall receive a factory applied shop primer in accordance with Section 3.2.C
4. Machined surfaces shall be cleaned and coated immediately after being machined, with a suitable rust resistant coating per manufacturer's recommendations.
5. All other ferrous surfaces shall be factory primed in accordance with Section 3.2.C, except ferrous surfaces obviously not to be painted shall receive a heavy shop coat of grease or other suitable rust resistant coating per manufacturer's

recommendations.

6. These coating shall be maintained as necessary to prevent corrosion during all periods of storage and erection until final acceptance by the owner.

- C. Schedule: The product model and coatings system numbers listed below are based on products by the Tnemec Company Inc. to establish the standard of quality. Equivalent products from other manufactures will be accepted provided they meet or exceed the performance of the listed products.

SURFACE / ITEM	SURFACE PREPARATION	Tnemec SHOP PRIME
METALS		
Submerged Ferrous Metals, Piping, Fittings, Valves and Equipment specified to be shop primed in their respective sections.	SSPC-SP10 Near White Metal Blast Cleaning	Series 1 Omnithane 2 to 3 mils
Enclosed Ferrous Metals, Piping, Fittings, Valves and Equipment specified to be shop primed in their respective sections.	SSPC-SP10 White Metal +Blast Cleaning	Series 1 Omnithane 2 to 3 mils
Weather Exposed Ferrous Metals, Piping, Fittings, Valves and Equipment specified to be shop primed in their respective sections.	SSPC-SP6 Commercial Blast Cleaning	Series 1 Omnithane 2 to 3 mils
Enclosed Ferrous Metals.	SSPC-SP6 Commercial Blast Cleaning	Series 1 Omnithane 2 to 3 mils
Galvanized Metal Lintels and Galvanized Metals built into the masonry and concrete	SSPC-SP1 Solvent Wiping followed by SSPC-SP16 Brush Blast Cleaning	Series 66HS Epoxoline 11 3 to 5 mils
Ferrous Metals in contact with or embedded in concrete or masonry	SSPC-SP6 Commercial Blast Cleaning	Series 66HS Epoxoline 11 3 to 5 mils
All Ferrous metals concealed in wood framing and not exposed to view	SSPC-SP3 Power Tool Cleaning	Series 1 Omnithane 2 to 3 mils
All Other Weather Exposed and Enclosed Ferrous Metals, including steel frames, overhead door, steel lintels and bollards	SSPC-SP6 Commercial Blast Cleaning	Series 1 Omnithane 2 to 3 mils

NOTES:

1. Surface preparation shall be as specified within this section and as noted in the table above are minimums. Surface preparation shall be in accordance with the manufacturer's written recommendations.
2. All dry film thickness indicated are the minimum required.
3. All ferrous metals and equipment delivered to the site with shop primers other than polyamide epoxy or alkyd primer indicated above, shall receive an intermediate coat as necessary for compatibility with epoxy top coats.
4. All ferrous, nonferrous in contact with concrete or masonry and galvanized metal lintels shall receive a polyamide epoxy primer with a minimum dry film thickness of 4 mils applied to the contact area.
5. Galvanized surfaces to be painted shall be treated as required by manufacturer to be compatible with the primer and top coats specified.

END OF SECTION

SECTION 10440

PORTABLE FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Portable fire extinguishers
- B. Wall Brackets

1.2 REFERENCES

- A. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops.
- B. National Fire Protection Association (NFPA) 10 - Portable Fire Extinguishers.
- C. Underwriters Laboratories (UL) 299 - Dry Chemical Fire Extinguishers.

1.3 SUBMITTALS

- A. General: Submittals shall be in accordance with specification Section 01340.
- B. Schedule: Indicate type, size, location, quantity and mounting heights.
- C. Product Data: Include data on extinguishers, brackets, operational features, materials, finishes, and anchorage.
- D. Closeout Submittals: Maintenance Data: Include test, refill, or recharge schedules and re-certification requirements.

1.4 QUALITY ASSURANCE

- A. Provide fire extinguishers complying with UL 711 and NFPA 10.
- B. Conform to applicable accessibility code for locating extinguishers.
- C. Manufacturer's certification that product meets or exceeds products specified.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. JL Industries
- B. Amerex Corp.
- C. Or equal.

2.2 MATERIALS

- A. Extinguishers:
 - 1. Multi-purpose dry chemical type, UL 299, heavy duty steel tank, Class 10A:120B:C, 20-pound nominal capacity.
- B. Brackets:
 - 1. Manufactures standard brackets, sized to accommodate extinguisher.

2.3 ACCESSORIES

- A. Mounting Hardware: Type best suited to application.

2.4 FINISHES

- A. Brackets: Baked enamel, black color.
- B. Extinguishers: Baked enamel, red color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount at locations shown on the Drawings.
- B. Install brackets in accordance with manufacturer's instructions, Place an extinguisher on each bracket.
- C. Set plumb, level, and rigid.
- D. Identification: Provide wall markers for bracket mounted fire extinguishers in readily visible location above extinguishers. Markers to be painted metal or decals complying with NFPA Standard No. 10 for fire classification of extinguisher.
- E. Charging of Extinguishers:
 - 1. Dry Chemical extinguishers: Deliver to project fully charged. Weigh each extinguisher at time of installation to prove fully charged condition and have witnessed by the Engineer.
 - 2. If discharged for any reason, refill at no additional cost to the Owner during construction period.

END OF SECTION

SECTION 11000EQUIPMENT - GENERALPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish, install and test all equipment specified in this Contract and as shown on the Drawings.
- B. Related Work Specified Elsewhere (When Applicable):
 - 1. Submittals are specified in Section 01340.
 - 2. Delivery, Storage and Handling is specified in Section 01600.
 - 3. Equipment Startup, Certification and Operator Training are specified in Section 01800.
 - 4. Site work is specified in Division 2.
 - 5. Concrete and grout are specified in Division 3.
 - 6. Field painting is specified in Section 09900.
 - 7. Surface Preparation and Shop Coatings are specified in Section 09905
 - 8. Controls and Instrumentation are specified in Division 13.
 - 9. Conveyors are specified in Division 14.
 - 10. Pipe, plumbing, and mechanical work are specified in Division 15.
 - 11. Electrical work and components, and variable frequency drives, are specified in Division 16.

1.2 QUALITY ASSURANCE

- A. Provide only equipment of proven reliability manufactured by reputable manufacturers.
- B. Acceptable manufacturers are listed in each equipment item section in this Division and are intended to indicate the type and quality of materials expected. Refer to the General and Supplemental Conditions for the manner in which "or equals" and "substitutes" will be evaluated.
- C. Certificates, patents, licenses or other required legalities, when applicable, are specified in each Section of this Division.
- D. The Specifications and Drawings direct attention to certain required features of the equipment but do not purport to cover all details entering into its design and construction. Nevertheless, the Contractor shall furnish the equipment complete in all details and ready for operation for the intended purpose.
- E. These Specifications are intended to provide standard equipment of a recognized manufacturer meeting all the requirements of the Specifications. Due to differences in such prefabricated equipment of various manufacturers, submit complete shop drawings, cuts, specifications, etc. to the Engineer to review for compliance with the Contract Documents prior to ordering any equipment. If the equipment differs materially from the dimensions given on the Drawings, submit complete drawings showing elevations, dimensions etc. for the installation. If Engineer's acceptance is obtained for alternate equipment, make any needed changes in the structures, piping or electrical systems necessary to accommodate the equipment at no additional cost

to the Owner.

- F. Workmanship shall be first class in all respects.

1.3 SUBMITTALS

- A. Provide shop drawings and samples as specified in the General Conditions and Section 01340 of the Construction Contract. Equipment Systems Manufacturers shall integrate all required shop drawings into a common package.
- B. Catalog Data: Submit manufacturer's literature and illustrations for all equipment to be installed, including dimensions, construction details, shop painting details, and materials by generic name.
- C. Installation Instructions: Submit complete sets of manufacturer's instructions for each equipment item, including equipment storage requirements.
- D. Complete Operation and Maintenance Manuals in compliance with Specification Section 01340.
- E. Certificates: Submit manufacturer's certification that equipment, accessories and shop painting meet or exceed the Specification requirements. Submit equipment performance testing results as required by these specifications. Should the proposed equipment not comply with all the specification requirements, all deviations from the specification requirements shall be listed.
- F. Submit all requirements for interface with controls and/or equipment furnished in Divisions 11, 13 and 16. Submit wiring diagrams as required to accurately depict all such interface requirements to ensure proper operations of each system or item of equipment.
- G. Provide certified bearing life calculations on all equipment bearings.
- H. Submittals are further specified in this Division.
- I. Guarantees/Warranties as specified below.
- J. Attention is directed to the fact that the Drawings are based upon a particular piece of equipment.
- K. If the equipment to be provided requires an arrangement differing from that indicated on the Drawings, the Contractor shall prepare and submit for review, detailed mechanical drawings showing all necessary changes. Such changes shall be at no additional cost to the Owner.
- L. Contractor shall provide a Submittal Certification from each individual Equipment Manufacturer certifying that the Equipment Manufacturer has:
 - 1. Reviewed the Construction Documents, the intended installation by the Contractor, and the intended functional and operational conditions;
 - 2. Determined all conditions to be acceptable; and
 - 3. Found no conditions which would cause the warranty to be void; or the equipment to function improperly, or not meet the performance requirements.The submittals will not be reviewed without the inclusion of these noted certifications. Process Equipment Manufacturer Submittal Certification Form is provided in Section 01340.
- M. Proposed equipment/valve identification tag information.

1.4 SEISMIC CONTROL

- A. Not Used.

1.5 GUARANTEE/WARRANTIES

- A. The Contractor shall provide the Owner with a Guarantee/ Warranty for the entire project in accordance with for a period of 1-year following the date of substantial completion. No shop drawings submittals are required for this item.
- B. Any specified extended warranties (i.e., those which run longer than the Contract Correction/ Warranty Period) shall be prepared in the name of the Owner and shall become effective after the completion of the Correction/ Warranty Period. The Contractor will be required to handle warranty problems during the Correction/ Warranty Period. Extended warranties shall meet the requirements specified in the relevant Section. Proposed extended warranty language shall be submitted to the Engineer for review as a part of the Shop Drawing process.
- C. Equipment that is supplied by a system supplier and is intended to function as a complete and integrated system shall be warranted accordingly.
- D. Any part of a mechanical equipment system that shows undue or excessive wear, or that fails due to normal operational conditions during the Correction/ Warranty Period, shall be considered as evidence of defective material or defective workmanship, and it shall be replaced with equipment or parts to meet the specified requirements at no cost to the Owner.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01600 for additional requirements.
- B. Coat all machined surfaces subject to corrosion with an easily removable rust preventive compound prior to shipment.
- C. Ship fabricated assemblies in the largest sections permitted by carrier regulations, properly labeled for field erection.
- D. Deliver equipment in manufacturer's original, unopened and undamaged packages, unless mounted on equipment assembly.
- E. Contractor shall store and maintain all equipment in strict accordance with the manufacturer's written short term and long-term storage requirements.
- F. Store in a manner to protect items with epoxy shop coatings from exposure to UV light which can cause chalking of the epoxy. Length of acceptable exposure prior to providing UV protective measures shall be in accordance with coating manufacturer's recommendations. This includes protection from UV light after installation while awaiting covering or filling of tanks, or prior to field painting for items scheduled to be top-coated
- G. Should damage occur, immediately make all repairs and replacements necessary to the satisfaction of the Engineer at no costs to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL DESIGN OF EQUIPMENT

- A. All parts and components of mechanical equipment shall be designed for satisfactory service under continuous duty without undue wear under the specified operating conditions.
- B. All parts of mechanical equipment shall be amply proportioned for all stresses which may occur during operations, and for any additional stresses which may occur during

fabrication and erection. Iron castings shall be tough, close-grained gray iron casting, Class 30, in accordance with ASTM A48, latest revision. Structural steel shall conform to ASTM A36.

- C. Mechanical equipment, including drives and electrical motors, unless otherwise noted, shall be supplied and installed in accordance with Occupational Safety and Health Act (OSHA) requirements. The Contractor's attention is drawn to the requirements for equipment guards. The noise level of equipment, drives and motors, unless otherwise noted, shall not exceed 90 dBA measured 3 feet from the unit under free field conditions.
- D. All equipment and machinery furnished under this Contract shall be the latest improved design suitable for the service specified. All equipment and machinery shall be designed and constructed to operate efficiently, continuously and quietly under the specified requirements with a minimum of maintenance, renewals and repairs. The design and construction of all equipment and machinery shall be such as to permit operation with minimum wear, vibration and noise when properly installed.
- E. Ample room for erecting, repairing, inspecting and adjusting of all equipment and machinery shall be provided. The design, construction and installation of all equipment and machinery shall conform to and comply with the latest safety codes and regulations.
- F. All equipment of identical size, type and service shall be the product of the same manufacturer.
- G. All equipment selected shall suit the general arrangement of the space in which it is to be installed.
- H. Unless otherwise specified, electrical SCR controller units shall be furnished with the driven equipment, mounted and factory aligned, where applicable. Wiring of motors and controls shall be in accordance with the requirements of Division 16 and other applicable portions of the Specifications. Electrical variable frequency drives shall be furnished and installed by the electrical contractor, unless otherwise noted as specified in Division 16.
- I. Suitable provisions shall be made for easy access for service and replacement parts.

2.2 BOLTS, ANCHOR BOLTS AND NUTS

- A. Furnish all necessary bolts, anchor bolts, nuts, washers, lock washers or locking nuts, plates and bolt sleeves in accordance herewith. Anchor bolts shall have suitable washers, lock washers and, where so required, their nuts shall be hexagonal.
- B. All bolts, anchor bolts, nuts, washers, lock washers, plates, and bolt sleeves shall be galvanized unless otherwise indicated below or specified elsewhere.
 - 1. Stainless steel hardware (minimum of Type 304, unless otherwise indicated) is required in all corrosive atmospheres, exterior areas, and/or areas with NEMA 4X or NEMA 7 rating.
 - 2. Stainless steel hardware (minimum of Type 316, unless otherwise indicated) is required in all submerged applications, including but not limited to the wetwells, headworks, dewatering rooms, chemical rooms, clarifiers, aeration basins, splitter structures, equalization or storage tanks, etc. For additional description and definition of submerged surfaces refer to Specification Section 09900.
- C. Expansion bolts shall have malleable iron and lead composition elements of the

- required number of units and size.
- D. Unless otherwise specified, stud, tap, and machine bolts shall be of the best-quality refined bar iron. Hexagonal nuts of the same quality of metal as the bolts shall be used. All threads shall be clean cut and shall conform to AN Standard B 1.1-1974 for Unified Inch Screw Threads (UN and UNR Thread Form).
 - E. Anchor bolts and expansion bolts shall be set accurately. If anchor bolts are set before the concrete has been placed, they shall be carefully held in suitable templates of acceptable design. Where indicated on the Drawings, specified, or required, anchor bolts shall be provided with square plates at least 4 in. by 4 in. by 3/8 in. or shall have square heads and washers and be set in the concrete forms with suitable pipe sleeves, or both. If anchor or expansion bolts are set after the concrete has been placed, all necessary drilling and grouting or caulking shall be done by the Contractor and care shall be taken not to damage the structure or finish by cracking, chipping, spalling, or otherwise during the drilling and caulking.
 - F. All anchors shall be designed and supplied by the equipment manufacturer. Anchors include, but are not limited to, anchor rods, epoxy anchors and expansion anchors. All anchor designs shall include the following:
 - 1. Anchors shall be designed for all applicable loads and load combinations in accordance with the Building Code applicable to the Project as by the equipment manufacturer. Equipment dynamic loads shall also be included with the other loads.
 - 2. Anchor design shall include the quantity, material, finish, diameter, type, spacing and concrete embedment depth of anchors. Design of epoxy and expansion anchors shall be based on cracked concrete.
 - 3. Expansion anchors are not permitted for exterior applications, wet service conditions, or dynamic loads. Cast-in anchor rods or epoxy anchors shall be used in these applications.
 - 4. All anchors shall be installed with the required embedment depth. If anchors are fully developed in the concrete equipment pad and are not embedded in the slab, the anchorage capacity of the pad to the slab shall be verified by the Engineer prior to placement of the pad.
 - 5. Anchors shall be no less than 3/8" diameter.
 - 6. Concrete strengths are as follows:
 - a. New concrete: $f'c = 4,000$ psi
 - b. Existing concrete: $f'c = 3,000$ psi
 - 7. Anchors shall be shown on the equipment shop drawings, with all the required information indicated.

2.3 FOUNDATIONS, INSTALLATION AND GROUTING

- A. The Contractor shall furnish the necessary materials and construct suitable concrete foundations for all equipment installed by the Contractor, even though such foundations may not be indicated on the Drawings. The tops of foundations shall be at such elevations as will permit grouting as specified below.
- B. All such equipment shall be installed by skilled mechanics and in accordance with the instructions of the manufacturer.
- C. In setting pumps, motors, and other items of equipment customarily grouted, the Contractor shall make an allowance of at least 1 in. for grout under the equipment

bases. Shims used to level and adjust the bases shall be steel. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise permitted, all grout shall be a suitable non-shrink grout.

- D. Grout shall be mixed and placed in accordance with the recommendations of the manufacturer. Where practicable, the grout shall be placed through the grout holes in the base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.
- E. Where such procedure is impracticable, the method of placing grout shall be as permitted by the Engineer. After the grout has hardened sufficiently, all forms, hoppers, and excess grout shall be removed, and all exposed grout surfaces shall be patched in an approved manner, if necessary. All foundation and grout exposed surfaces shall be given a burlap-rubbed finish and painted with at least two coats of the epoxy-based paint specified for concrete.
- F. If threaded rod with lower support nuts are used to secure the equipment in place temporarily during concrete equipment pad placement, the support nuts shall be removed prior to grouting so that the threaded rod anchor bolts are not supporting the equipment and the top nuts can be tightened to secure the equipment directly to the large bedding surface provided by the non-shrink grout and concrete equipment pad. Equipment foundations shall be designed to absorb equipment vibration and transmit forces to building structure or ground. Contractor shall demonstrate that this has been completed to the RPR prior to grouting.

2.4 ELECTRIC MOTORS

- A. Unless otherwise specified or permitted by the Engineer, all electric motors furnished and installed by the Contractor shall conform to the requirements hereinafter set forth.
- B. All equipment motors and appurtenances (e.g., switches, instruments, etc.) shall meet the area classification and NEMA requirements as listed on Drawing E-1.
- C. All motors shall be specifically designed for the installation orientation required by the equipment submitted (i.e., horizontal motor design for horizontal installation, vertical motor design for vertical installation). Universal motors shall not be allowed.
- D. Ratings of Motors
 - 1. Every motor shall be of sufficient capacity to operate the driven equipment under all load and operating conditions without exceeding its rated nameplate current or power or its specified temperature limit.
 - 2. When the horsepower rating is specified for a motor, the motor furnished shall meet the requirements of the output specified. When the horsepower rating is not specified, the motor shall have sufficient capacity to operate the driven equipment as given in the Detailed Specifications.
 - 3. All electric motors shall be UL recognized.
 - 4. Motor shall have a service factor of 1.15, unless otherwise specified.
- E. Type of Motors
 - 1. All motors shall be NEMA Design B, and shall have starting characteristics and ruggedness as may be necessary under the actual conditions of operation and, unless otherwise specified, shall be suitable for full-voltage starting.

2. Motors shall be manufactured by General Electric Co., Reliance, Toshiba, Siemens, or be an equivalent product, that meets all the requirements herein.
3. All motors shall have Class F insulation with temperature rise in accordance with NEMA Standards for Motors and Generators and based on a maximum ambient temperature of 40 deg. C.
4. Motors Installed in Class I/ Division 1 Hazardous Locations:
 - a. Motors shall be explosion-proof (XP) rated for Class I/ Division 1/ Group C and D rated for hazardous locations and shall meet the requirements of the National Electric Code and other safety codes pertaining thereto.
 - b. Motors shall include integral high temperature thermostats or similar device with a high temperature interlock to shut down the motor and auxiliary contact to activate an alarm condition.
 - c. Thermostats shall be normally closed, hermetically sealed and rated a minimum of 0.5A at 120 VAC. The thermostats shall be set so that the temperature of the motor will not exceed the auto-ignition temperature for a Class I/ Division 1/ Group C and D location.
5. Motors Installed in Class I/ Division 2 Hazardous Locations:
 - a. Motors shall be either explosion-proof (XP) rated for Class I/ Division 1/ Group C and D or Class I/ Division 2 Group C and D locations. Motors may be TEFC rated; however, TEFC motors used in hazardous areas shall be non-sparking type (brushless) and shall have non-sparking cooling fans. All motors shall meet the requirements of the National Electric Code and other safety codes pertaining thereto.
 - b. Motors shall include integral high temperature thermostats or similar device with a high temperature interlock to shut down the motor and auxiliary contact to activate an alarm condition.
 - c. Thermostats shall be normally closed, hermetically sealed and rated a minimum of 0.5A at 120 VAC. The thermostats shall be set so that the temperature of the motor will not exceed the auto-ignition temperature for a Class I/ Division 2/ Group C and D location.
6. All motors shall be NEMA Premium Efficiency type. The nominal and/or minimum guaranteed efficiency shall be printed on the motor nameplate. The efficiency values shall conform to Energy Policy Act of 1992, unless exempted, and shall be as indicated in the following table:

Nominal Full Load Motor Efficiencies						
	Open Motors			Enclosed Motors		
HP	3600 rpm	1800 rpm	1200 rpm	3600 rpm	1800 rpm	1200 rpm
1	77.0*	85.5	82.5	77.0	85.5	82.5
1.5	84.0	86.5	86.5	84.0	86.5	87.5
2	85.5	86.5	87.5	85.5	86.5	88.5
3	85.5	89.5	88.5	86.5	89.5	89.5
5	86.5	89.5	89.5	88.5	89.5	89.5
7.5	88.5	91.0	90.2	89.5	91.7	91.0
10	89.5	91.7	91.7	90.2	91.7	91.0
15	90.2	93.0	91.7	91.0	92.4	91.7
20	91.0	93.0	92.4	91.0	93.0	91.7
25	91.7	93.6	93.0	91.7	93.6	93.0
30	91.7	94.1	93.6	91.7	93.6	93.0
40	92.4	94.1	94.1	92.4	94.1	94.1
50	93.0	94.5	94.1	93.0	94.5	94.1
60	93.6	95.0	94.5	93.6	95.0	94.5
75	93.6	95.0	94.5	93.6	95.4	94.5

F. General Design of Motors

1. Motors shall comply with the latest NEMA Standards for Motors and Generators, unless otherwise specified. Motors shall not run beyond nominal full speed rpm.
2. Motor windings shall be braced to withstand successfully the stresses resulting from the method of starting. The windings shall be treated thoroughly with acceptable insulating compound suitable for protection against moisture and slightly acid or alkaline conditions.
3. Bearings shall be of the self-lubricating type, designed to ensure proper alignment of rotor and shaft and to prevent leakage of lubricant.
4. Bearings for open motors shall be of the sleeve or ball type, as specified under the respective items of mechanical equipment. Bearings for totally enclosed and explosion-proof motors shall be of the ball type. The exception to this shall be belt-drive applications in which case the motor manufacturer shall determine if roller bearings are required in lieu of ball bearings due to higher radial loads.
5. Vertical motors shall be provided with thrust bearings adequate for all thrusts to which they can be subjected in operation.
6. Vertical motors of the open type shall be provided with drip hoods of acceptable shape and construction. When the drip hood is too heavy to be easily removed, provision shall be made for access for testing.
7. All motors installed above or within potable water storage tanks shall use food grade lubrication that is NSF approved.

G. Wound-Rotor Induction Motors

1. Wound-rotor motors shall be designed for operation of the motor-driven equipment under the conditions specified in the Detailed Specifications.
2. Motors shall be of the wound-rotor, induction type suitable for speed control by rotor resistance.

3. The collector rings shall be constructed of hard composition metal of sufficient conductivity and ample contact surface. The rings shall be mounted accurately and securely on the shaft by means of acceptable insulating construction. The leads to the collector rings shall be fastened to and insulated from the shaft in a suitable manner.
 4. The collector rings and brushes for the wound-rotor induction motors shall be suitable for operation in an atmosphere containing moisture.
 5. The brushes shall be of the electrographite type, or other suitable type, of sufficient hardness and conductivity and shall have ample contact surfaces. Brush holders shall be provided with adjustable, spring-tension devices. Brushes shall be connected to the holders with tinned, flexible, copper-wire pigtails so arranged that no appreciable current shall be carried through the sliding contacts or springs. Brushes shall operate without noise or chattering. Rings and brushes shall be located on top of the motor and shall be easily accessible for inspection and maintenance.
- H. Synchronous Motors
1. Synchronous motors shall comply in all respects with the latest NEMA Standards for Motors and Generators, and AN Standard C50 for Rotating Electrical Machinery.
 2. Synchronous motors shall be designed for operation of the motor-driven equipment under the conditions specified in the Detail Specifications.
 3. The temperature rise (based on a cooling temperature not exceeding 40 deg. C. and an altitude not exceeding 3,300 ft.) in the various parts of the motors, when operating continuously at rated voltage, frequency, and power factor, shall conform to the applicable requirements of the above- mentioned NEMA Standards.
 4. Synchronous motors shall be manufactured by General Electric Co. or be an equivalent product.
- I. Single-Phase Motors with Auxiliary Devices
1. Single-phase motors requiring switching devices and auxiliary starting resistors, capacitors, or reactors shall be furnished as combination units with such auxiliaries either incorporated within the motor housings or housed in suitable enclosures mounted upon the motor frames. Each combination unit shall be mounted upon a single base and shall be provided with a single conduit box.
- J. Motor Terminal Boxes and Leads
1. Motors shall be furnished with oversize conduit terminal boxes to provide for making and housing the connections and with flexible leads of sufficient length to extend for a distance of not less than 4 inches beyond the face of the box. The size of cable terminals and conduit terminal box holes shall be as permitted by the Engineer. An acceptable type of solderless lug shall be furnished. Totally enclosed and explosion-proof motors shall have cast-iron terminal boxes.
- K. Special Motors

1. Hoists and other devices complying with special safety codes shall be furnished complete with their control equipment and with all accessories and safety devices for code-approved, safe, and efficient operation.
- L. Premium Efficiency Motors – “For Use with Variable Frequency Drives”
 1. Motors other than inverter duty rated type which are used on variable frequency drive equipment shall have an insulation system that is inverter grade to meet NEMA MG1-2016, Class F insulation system with a Class B temperature rise at a 1.15 service factor. Motors shall be wound with inverter duty wire and shall be multi-dipped and baked in a polyester, Class H varnish.
 2. Nameplate on motor shall be stamped indicating motor is “Certified for Use with VFDs”.
 3. Motors of the sizes indicated below and operated on variable frequency drives shall be equipped with a maintenance free, conductive micro fiber, shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge electrical shaft currents within the motor and/or its bearings to ground.
 - a. Motors between 25 HP and up to 100 HP shall be provided with a minimum of one shaft grounding ring installed either on the drive end or non-drive end.
 - b. Motors over 100 HP shall be provided with an insulated or hybrid bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer or Contractor and shall be installed in accordance with the manufacturer’s recommendations.
 - c. Grounding rings may be external or internal to the motor for open drip proof motors (ODP), totally enclosed fan cooled (TEFC) and totally enclosed non-ventilated (TENV). Grounding rings shall be internal to the motor for all Class 1/ Division 1 and Class 1/ Division 2 motors. Grounding rings shall not interrupt or alter the motor design flame path.
 - d. Grounding rings shall be AEGIS or equal.
- M. Premium Efficiency Motors – “Inverter Duty Rated”
 1. Inverter Duty Rated motors which are used on variable frequency drive equipment shall meet the following requirements:
 - a. Motor shall be suitable for operation over entire speed range indicated without causing motor overheating at any condition.
 - b. Forced ventilation type inverter duty rated motors with a separate external continuously operating fan shall not be acceptable.
 - c. Motors installed in Division 1 hazardous (classified) location shall be identified as acceptable for variable speed when used in Division 1 locations.
 - d. Motor shall have Class F insulation with a Class B temperature rise at a 1.0 service factor (non-sinewave power) and 40°C ambient conditions per NEMA MG1-2016.
 - e. Motor shall be wound with inverter duty wire and phase paper and shall be multi-dipped and baked in polyester, Class H varnish.

- f. Nameplate on motor shall be stamped indicating motor is "Inverter Duty Rated".
 - 2. Motors of the sizes indicated below and operated on variable frequency drives shall be equipped with a maintenance free, conductive micro fiber, shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge electrical shaft currents within the motor and/or its bearings to ground.
 - a. Motors between 25 HP and up to 100 HP shall be provided with a minimum of one shaft grounding ring installed either on the drive end or non-drive end.
 - b. Motors over 100 HP shall be provided with an insulated or hybrid bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer or Contractor and shall be installed in accordance with the manufacturer's recommendations.
 - c. Grounding rings may be external or internal to the motor for open drip proof motors (ODP), totally enclosed fan cooled (TEFC) and totally enclosed non-ventilated (TENV). Grounding rings shall be internal to the motor for all Class 1/ Division 1 and Class 1/ Division 2 motors. Grounding rings shall not interrupt or alter the motor design flame path.
 - d. Grounding rings shall be AEGIS or equal.
- N. Submersible Motors
 - 1. Motors which are rated for submersible use shall be of the highest efficiency in the industry for this type of motor and horsepower rating.
 - 2. When used in conjunction with variable frequency drive equipment, the submersible motor shall be rated for inverter duty with Class H insulation.
 - 3.

2.5 LUBRICATION FITTINGS

- A. All lubrication fittings shall be brought to locations that are readily accessible to operators from normal operating walkways or platforms. Equipment lubrication fittings shall be extended to outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards, floor plating or other obstruction, and to eliminate creating falling hazards by unusual elevations. Fittings shall be buttonhead type. Lubrication fittings shall be mounted together wherever possible.
- B. Pressure grease-lubricated fittings shall be the "Zerk Hydraulic" type or the "Alemite" type.
- C. Housings of grease-lubricated bearings shall be automatically exhausted to the atmosphere to prevent excessive greasing.
- D. Oil drains shall be piped to a location outside the equipment frame for ease of draining. Provide ball valve for positive shutoff. Pipe shall be type-L copper or galvanized steel.

2.6 SPARE PARTS AND SPECIAL TOOLS

- A. For each type of equipment furnished, the Contractor shall provide spare parts, as specified on the respective sections of the Division, and a complete set of all special

tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation, maintenance, and disassembly of such equipment.

- B. Tools shall be high-grade, smooth, forged, alloy, tool steel. Grease guns shall be lever type.
- C. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment.
- D. All spare parts and special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts and special tools until completion of the work, at which time they shall be delivered to the Owner.
- E. Spare parts shall be appropriately labeled and containerized, and shall be properly packaged for long-term storage.
- F. If the Contractor utilizes a spare part to remedy an issue during the Contract work (through Final Completion) they shall replace the spare part at no additional cost to the Owner.

2.7 EQUIPMENT DRIVE GUARDS

- A. All equipment driven by open shafts, belts, chains, or gears shall be provided with all-metal or rigid fiberglass OSHA approved guards enclosing the drive mechanism. Guards shall be securely installed but shall be removable with quick open latches.
- B. Guards shall be constructed of galvanized sheet steel or galvanized woven wire or expanded metal set in a frame of galvanized steel members, unless otherwise specified.
- C. Guards shall be secured in position by steel braces or straps which will permit easy removal for servicing the equipment.
- D. The guards shall conform in all respects to all applicable safety codes and regulations.

2.8 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis.
- B. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

2.9 NAMEPLATES

- A. Each piece of equipment shall be provided with a substantial nameplate of noncorrodible metal, securely fastened in place and clearly and permanently inscribed with the manufacturer's name, model or type designation, serial number, principal rated capacities, electrical or other power characteristics, and similar information as appropriate.
- B. An enlarged paper copy of all the nameplate data on equipment and motors shall be provided in the Shop Drawings and Operation and Maintenance Manuals.

2.10 SURFACE PREPARATION AND SHOP COATINGS

- A. Provide surface preparation and shop coatings in accordance with Specification Section 09905.

2.11 ELECTRICAL CONTROLS

- A. Additional controls for various items of equipment are specified under Division 13 and/or Division 16, as indicated on the Drawings, and as specified. Due to potential differences in electrical requirements for equipment of various manufacturers, the Contractor shall coordinate the electrical requirements of the equipment supplied with the work specified in Division 13 and/or Division 16.
- B. Provide auxiliary contacts as required for remote status and alarm conditions. Contractor shall coordinate each piece of equipment. Refer to the Electrical and Instrumentation Drawings.
- C. Electrical controls for all equipment shall comply with the requirements of Division 16 and the National Electric Code, including provisions to allow each piece of equipment to be locked out/tagged out for maintenance or repairs.
- D. Control panels shall be constructed in conformance with UL 508A and bear the UL 508A seal confirming the construction. UL inspection and seal application can be accomplished at the panel fabrication facility or by field inspection by UL inspectors. Obtaining the UL seal and any inspections shall be provided at no additional cost to the Owner.

2.12 GAUGES

- A. General:
 - 1. Unless otherwise indicated, gauge assemblies shall be complete with 1/2-inch brass pipe and fittings, 1/2-inch ball valve with bronze body, stainless steel ball, Teflon seats and a tee with a brass test cock with female outlet end all arranged to allow field checking with a 4½-inch test gauge. Gauge assembly piping and valves for chemical feed systems shall be compatible with the chemicals being handled.
 - 2. All gauges shall be equipped with snubbers or other protective throttling device(s) to dampen workings and pointer. If single snubber does not correct pulsing, provide additional snubbers in series.
 - 3. All gauges shall meet requirements as outlined hereinafter.
 - 4. All gauges provided are to be from the same manufacturer.
 - 5. All gauge assemblies shall be supported by brackets to prevent excessive vibration that will cause damage to the gauge assembly.
 - 6. The ranges of the gauges shall be suitable for any range of pressure that can occur during operation.
 - a. Suction gauges shall be compound-type, having a range of -15 feet to 0 feet to +30 feet of water.
 - b. Discharge gauges shall be selected at the nearest standard range which provides a top limit above the pump shutoff head or pump relief valve setting. Discharge gauges shall read in feet of water.
- B. Process Liquid Applications:
 - 1. Gauges shall be round black case, 4½-inches diameter, 1/2-inch NPT bottom male threaded connections, glycerin filled, stainless steel rack and pinion movement, black micro-adjusted rezeroing pointers, rack and pinion movement, black micro-adjusted rezeroing pointers, and black figures with white plastic dials and a threaded ring. Gauges shall have an accuracy of 1/2 percent of scale range.

2. Gauges shall be furnished for the suction and discharge nozzle of each pump and where called for on the Drawings or within other Specification Sections.
 3. All gauge assemblies shall be supported by brackets to prevent excessive vibration that will cause damage to the gauge assembly.
- C. All Other Applications (Chemical, Process Water, Seal Water, Air)
1. Gauges shall be round black case, 2-1/2-inch, 1/4-inch NPT stem mount, glycerin filled, polycarbonate window, stainless steel bourdon tube and rack and pinion movement, black anodized aluminum micro-adjusted rezeroing pointers, white aluminum dial with black lettering. Gauges shall have an accuracy of 1.5% of full range. For chemical feed systems, all materials of construction shall be compatible with process chemical.
 2. All gauge assemblies shall be supported by brackets to prevent excessive vibration that will cause damage to the gauge assembly.
- D. Diaphragm Seals
1. Gauges shall be provided with factory-mounted protective diaphragm assembly and snubber. Diaphragm assembly shall be cleanout type, which will allow cleaning of the lower diaphragm assembly without breaking the seal or refilling and shall not require recalibration of the gauge.
 2. The diaphragm shall be 316 stainless steel with a 316 stainless steel housing (process and instrument flanges) and shall be fitted with a bleed screw on the instrument flange, and flushing connection on the process flange. Connecting bolts and nuts shall be 316 SS. Other diaphragm materials will be considered for acceptance on a case-by-case basis when dictated by chemical compatibility, or as specified below.
 - a. Sodium Hypochlorite: PVC/ Teflon or Hastelloy C-276
 3. The diaphragm shall be rated for gauge operating pressure range. Provide a locking plate or lock-wire to prevent turning of the assembly and to maintain the factory calibration.
- E. Process Isolator Diaphragm Ring Seal: Shall be provided for all gauges on wastewater sludge, chemical slurries, grit and polymer applications, as specified in other Division 11 Specifications, and as shown on the Drawings. All other gauge applications shall be provided with a diaphragm seal as specified above
1. Provide a wafer-style pressure isolation flange to isolate the connected gauge from the process fluids.
 2. The ring shall be constructed of 316 stainless steel meeting ANSI B16.5 Class 150 standards.
 3. The pressure shall be transferred from an elastomeric ring embedded around the inside diameter of the flange to a 1/2" NPT port on the outside of the flange with isolation needle valve.
 4. All nipples, valves and fittings will be 316 stainless steel.
 5. Liner material:
 - a. Wastewater/Sludge Application: NBR, natural rubber or EDPM
 - b. Polymer Applications: NBR
 6. Fill fluid: Silicon (10Cst)
 7. Pressure gauge: per this section
 8. The pressure gauge and diaphragm seal shall be factory assembled and tested.

9. Manufacturers:
 - a. Ashcroft Type 80 Iso-Ring
 - b. Red Valve Series 48
 - c. Or equal
- F. Gauges Assemblies shall be manufactured by:
 1. Ametek U.S. Gauge Division
 2. Ashcroft
 3. Trerice
 4. or equal.
- G. Contractor shall provide a gauge schedule listing all gauges, functions, locations, scales, etc., as part of the shop drawing submittal package.

2.13 EQUIPMENT AND VALVE IDENTIFICATION TAGS

- A. All new process equipment and valves shall be identified by a color-coded identification valve tag provided and installed by the Contractor. The tags shall be provided with identifying numbers and letters to match those as shown on the Drawings. Contractor shall submit a complete list of proposed Identification Tag information and it shall be reviewed/confirmed with the Engineer and Owner through the submittal process prior to ordering any tags. In general, tag information shall match the information provided on the Drawings.
 - 1.
- B. All identification tags shall be provided with sufficient lengths of chain for attachment to the respective equipment and/or valve.
- C. Tags shall conform to the following specifications:
 1. The tags shall be 2.5-inch diameter, 1/16" thick, rigid, multi-layered sandwich laminate with contrasting inner and outer colored acrylic plastic layers. Top hole size is 5/32" for hanging tags.
 2. Tags shall be available in 7 different outside colors. Owner and Engineer shall select up to 4 different colors for the project.
 3. Tags shall have up to three lines engraved on a side and eight characters per line of identification information. Tags shall be engraved one side.
 4. Tags shall be secured to valves with nylon cable ties or adjustable metal bead chain. Securing method shall be selected by the Owner and Engineer.
 5. Tags secured to equipment shall be fastened to a flat visible surface by a minimum of two SS screws or SS pop rivets.
 6. Tags shall have a service temperature of -40°F to 175°F
 7. Manufactured by Seton Name Plate Corporation, New Haven, CT, Brimar Industries, Garfield, NJ or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Contractor shall carefully inspect receiving structures and anchor supports for defects in workmanship prior to equipment arrival.
- B. Contractor shall carefully inspect all equipment for:
 1. Damage in shipping.

2. Defects in workmanship and materials.
3. Tightness of all nuts and bolts.
- C. Inspection shall include, but not be limited to, the following as applicable:
 1. Soundness (without cracked or damaged parts).
 2. Correctness of setting, alignment, and relative arrangement of various parts.
 3. Adequacy and correctness of packing, sealing and lubricants.
 4. Completeness in all details, as specified.
- D. Field Quality Control
 1. As part of the equipment cost, the Contractor shall provide the services of a duly authorized Manufacturer's representative to assist the Contractor with equipment adjustment, start-up, and necessary testing to prove that the equipment is in proper and satisfactory operating condition.
 2. On completion of the work, the Manufacturer's representative shall provide written certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void, as outlined in the attached equipment certification form.
 3. As part of the startup services, the Manufacturer's representative shall provide the Owner's personnel with training in the proper operation and maintenance of all associated equipment. The equipment training certification form shall be used for this purpose.
 4. When the work is substantially complete the Contractor will be required to demonstrate, to the satisfaction of the Engineer, the ability of all equipment to operate as intended without defect including binding, vibration, jamming, overheating, etc.

3.2 PREPARATION

- A. Provide all required adhesives, sealants, insulation, lubricants, waterproofing, fireproofing or other protection specified in each Section of this Division.

3.3 INSTALLATION

- A. Contractor shall install equipment in accordance with Manufacturer's requirement. Manufacturer(s) shall work with the Contractor to ensure that the equipment has been properly installed.
- B. Do not install equipment until all defects or inadequacies in receiving structure have been corrected to meet Specifications.
- C. Erect and lubricate equipment in strict accordance with the manufacturer's instruction. Installation shall include all oil and grease required for proper operation.
- D. All equipment mechanisms shall withstand all stresses that may occur during fabrication, erection, and intermittent or continuous operation.
- E. Contractor to furnish and install supports as indicated on the Drawings, and as required by the equipment manufacturer.
- F. Thoroughly clean all equipment and appurtenant piping to remove all dirt, grease, mill scale, and other foreign matter and touch up factory finish to the satisfaction of the Engineer.

3.4 STARTUP AND TESTING

- A. Test and adjust all equipment in accordance with the general requirements of Specification Section 01800, and the specific requirements of the various Division 11 Specification Sections.
- B. Demonstrate the equipment's ability to operate without overloading jamming, excessive vibration, etc. during normal operation conditions.
- C. Demonstrate the equipment's ability to meet all the performance requirements specified for the equipment system to make a complete operational system, suited for its intended use.

3.5 EXISTING EQUIPMENT RELOCATION

- A. All relocated equipment shall be reconditioned and serviced prior to operation in the new locations. Equipment shall be cleaned, rust removed, re-primed and painted in accordance with Section 09900, balanced, lubricated, oiled, calibrated and properly wired and plumbed to provide the intended service. Start-up of relocated equipment shall be done in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 11310

PUMPS - GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish, install, test and place into satisfactory operation pumping equipment and appurtenances as shown on the Drawings, as specified herein and as required for a complete installation.
2. Contractor will perform pump tests in the Engineer's presence to indicate that pump efficiency, capacity, and discharge head conform to specifications in Pump Schedule in this Division.

B. Related Work Specified Elsewhere (When Applicable) :

1. Additional requirements in Sections 01800 and 11000.
2. Surface preparation and shop coatings are specified in Section 09905.
3. Field Painting is specified in Section 09900.
4. Instrumentation is specified in Division 13.
5. Piping and valves are specified in Division 15.
6. Electrical is specified in Division 16.

1.2 QUALITY ASSURANCE

A. In accordance with the requirements of Section 11000.

B. All pumping equipment shall be designed, constructed, installed and tested in accordance with the best practice and methods and the standards of the Hydraulic Institute.

C. Additional performance requirements are outlined in pump specifications.

1. Pumps shall meet all performance requirements listed in this specification, and associated specifications.
2. In the event that the pump(s) equipment fails to meet the performance requirements specified, the Engineer shall have the right to require the Manufacturer to modify or replace the pumping equipment to enable said system to meet the performance requirements specified.
3. A second test, and any subsequent tests as may be necessary to ensure compliance with the Specifications shall be performed at no additional cost to the Owner.
4. All costs arising from project delays caused by failure to meet the performance requirements specified herein shall be borne by the Manufacturer and shall be responsible to the Contractor for any liquidated damages incurred due to any delay in passing all factory testing.

D. Only pumping units having wire-to-water efficiencies within a reputable manufacturer's equipment range of efficiencies will be accepted.

1.3 SUBMITTALS TO THE ENGINEER

A. In accordance with the requirements specified in Section 01340 and 11000. Submit

such shop drawings, manufacturer's literature, short-term and long-term storage requirements, and operations and maintenance manuals.

- B. Submit the following information for all pumps specified:
 - 1. Manufacturer's rating curves showing the following pump characteristics for each unit of flow:
 - a. Total dynamic head.
 - b. Brake horsepower.
 - c. Efficiency.
 - d. Required net positive suction head.
 - e. Allowable suction lift.
 - 2. Variable speed units:
 - a. Variable speed curves with at least five speeds plotted from maximum RPM to minimum RPM required to obtain the minimum pump flows at the heads indicated in the pump schedule.
 - 3. Literature, layout drawings and typical specification describing pumping equipment, showing all important details of construction and dimensions.
 - 4. Maintenance instructions shall be furnished to indicate operation, assembly, disassembly and troubleshooting.
 - 5. Mechanical seal drawing shall be furnished indicating service conditions, materials of construction, and basic interface dimensions.
 - 6. Literature and Layout Drawing for the pump seal water system supply and drain piping.
 - 7. Literature, Schedule and Layout Drawing for pump Gauge assemblies.
- C. After fabrication and prior to shipment, shop test completed pump and motor assemblies indicated in the Pump Schedule for performance in accordance with the Hydraulic Institute Standards and submit certified copies of the pump and motor performance data furnished.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with the requirements of Section 11000. Manufacturer shall deliver equipment to the project site where and when directed by the Contractor.

1.6 WARRANTY

- A. In accordance with the requirements of Section 11000.

PART 2 - PRODUCTS

2.1 PUMPING SYSTEM

- A. General:
 - 1. Pump:
 - a. Pump type and use are specified in Pump Schedule in this Section.
 - b. See the Specification Section noted in the Pump Schedule for additional information for each specific pump type.
 - c. Pump shall be suitable for intended purpose as specified and as shown on Drawings.
 - d. Pumps designated for a certain function shall be supplied by same manufacturer.

- e. Pumps for all functions need not be supplied by the same manufacturer.
 - f. All parts shall be designed and proportioned to have liberal strength, stability and stiffness to perform required function.
 - g. Provide ample room and fittings for inspection repairs and adjustments.
 - h. Pump base accurately aligned, sized and rigidly anchored into position in accordance with Drawings.
 - i. Anchor bolts, plates, nuts and washers shall be SAE bolt steel of ample size and strength for purpose intended, furnished and installed by Contractor in accordance with manufacturer's instructions.
 - j. Provide adaptor flanges, as necessary, to match piping system.
 - k. Brass or stainless steel name plates providing manufacturer's name, rated capacity, total dynamic head, operating speeds and other pertinent data shall be attached to pump equipment.
2. Motors:
- a. Refer to requirements in Section 11000.
 - b. Type specified in the Pump Schedule in this Division.
 - c. All motors shall be of nationally known manufacturer and conform to NEMA standards and specifications.
 - d. Maintain sufficient capacity to operate pump throughout designated operating range without exceeding name plate rating for current and power.
 - e. Vertical motors provided with radial keyways to absorb thrust caused by the shafting.
3. Mechanical Seals (unless otherwise indicated).
- a. General:
 - 1) Mechanical seals shall be constructed of materials which will not be subject to attack by the contacting liquids and shall be suitable for temperatures to which they are subjected.
 - 2) Seal wearing face materials shall be solid construction only; no overlays, deposited castings or sprayed on coatings are permitted.
 - 3) Seal face materials shall be as specified below.
 - 4) Elastomeric parts such as O-rings, friction rings, etc. shall be made of fluorocarbon (Viton, Fluorel, Kalrez, Kel-F, etc.), unless otherwise specified.
 - 5) Springs should be manufactured from ant-corrosive materials such as Hastelloy C or Elgiloy and preferably located out of the pumped fluid.
 - 6) Metal hardware shall be constructed of 316 SS.
 - 7) Stuffing boxes for mechanical seals on pumps for contaminated water service (sludge, grit, wastewater, scum, reclaimed water, etc.) shall be drilled and tapped for connection of a clean water purge supply.
 - 8) The Contractor shall coordinate with the pump manufacturer and seal manufacturer to determine if the pumps will be shipped with the mechanical seals installed. If the pumps are shipped with the seals installed the pump manufacturer's or seal manufacturer's qualified

factory trained field representative shall inspect the seal prior to startup and certify that the installation is such that nothing would nullify the warranty. If the pumps are shipped without the seals installed, the seals shall be installed on site by the pump or seal manufacturer's representative at the project site.

- 9) Acceptable Manufacturers are:
 - (1) John Crane
 - (2) A. W. Chesterton Company
 - (3) or equal.
- b. Mechanical Seal Arrangements:
 - 1) See Section 11319A.
4. Pump Shaft Packing:
 - a. When pump shaft packing is indicated in the Pump Schedule, the packing shall be compatible with the fluids being pumped and as recommended by the pump manufacturer.
 - b. Provide a replaceable shaft wear sleeve.
 - c. Provide lantern ring when a cooling fluid is used. Active throat bushings shall be utilized to reduce flushing water requirements.
5. Pump Gauges:
 - a. Provide 4 inch process gauges assemblies, one suction gauge assembly and one discharge gauge assembly per process pump, as detailed on the Process Drawings Gauge Assembly detail, unless otherwise specified. Gauges shall be provided in accordance with Section 11000.
6. Surface Preparation and Shop Coatings
 - a. Provide surface preparation and shop coatings in accordance with Specification Section 09905.
7. Field Coatings
 - a. Provide field coatings in accordance with Specification Section 09900.
8. Spare Parts:
 - a. Spare parts shall be delivered at the same time as the equipment to which they pertain.
 - b. The Contractor shall properly store and safeguard such spare parts until Substantial Completion of the work, at which time they shall be delivered to the Owner.
 - c. Parts shall be packaged in individual suitable containers labeled with the part number, name and quantity.

2.2 PUMP SCHEDULE

- A. Raw Sewage Pumps: Section 11319A
 1. Location: Old Norwich Road Pump Station (Lower-Level Pump Room)
 2. Function: Pump raw wastewater from wetwell to discharge point in the collection system
 3. Number of Units: Three (RSP-1, RSP-2, RSP-3)
 4. Type: Dry Pit Submersible Non-Clog Centrifugal Pump
 5. Capacity: (each)

- a. Design: 1,000 GPM at 142 ft. TDH with a minimum hydraulic efficiency of 65%.
 - b. Maximum NPSHR: 12.0 feet
 - c. No motor overload or pump cavitation at any point on the curve.
 6. RPM: 1800 rpm maximum.
 7. Impeller: 11-inch.
 8. Drive: Variable frequency drives (provided under Division 16) provided with local and remote controls capable of variable speed operation as specified.
 9. Motor: 85 HP, SUBM, 1800 RPM, 460V, 3 phase, 60 Hz; inverter duty rated; Provide certification from the motor manufacturer that the motor will not overheat at the low speed range.
 10. Control: Control shall be as specified in Division 13. Manufacturer to provide motor temperature and seal failure detection devices.
- Remarks: Sulzer/ABS Model XFP 105J-CB2 PE630/4 .

PART 3 - EXECUTION

3.1 EXAMINATION, PREPARATION AND INSTALLATION

- A. In accordance with the requirements of Section 11000 and the manufacturer's written instructions.

3.2 START UP AND TESTING

- A. In accordance with the requirements of Section 01800 and 11000.
- B. Perform all adjustments necessary to place equipment in satisfactory working order and to meet performance testing requirements. If equipment fails to meet performance requirements, the Contractor shall modify or replace the equipment at no additional cost to the Owner.

3.3 CLEANING AND FIELD COATINGS

- A. In accordance with the requirements of Section 09900 and 11000.

3.4 TRAINING AND WARRANTY PERIOD SUPPORT

- A. In accordance with the requirements of Section 01800.

END OF SECTION

SECTION 11312HORIZONTAL CENTRIFUGAL PUMPS
(PLANT WATER PUMP)PART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish and install horizontal, close coupled, single stage, end suction centrifugal pumps with appropriate accessories in accordance with type and use as specified herein and as shown on the Drawings.
- B. Related Work Specified Elsewhere (when applicable):
 - 1. Additional requirements as specified in Sections 01800, 11000 and 11310.

1.2 QUALITY ASSURANCE

- A. Acceptable Manufacturer's:
 - 1. Goulds Pumps, Inc. G&L Division, Seneca Falls, NY
 - 2. Or equivalent.

PART 2 - PRODUCTS2.1 MATERIALS

- A. Horizontal Centrifugal Pumps:
 - 1. Pump:
 - a. Goulds Model #22BF1J5A0.
 - b. Pump size 2" NPT Inlet, 1" NPT discharge, 50 gpm @ 70 psi, 5 HP, 3,500 RPM, 230/460 volt, 3-phase, 60 Hz, TEFC motor.
 - 2. Pump Casing:
 - a. Constructed of hard closed grain cast iron #30 (ASTM A48-Latest Rev.) of ample thickness, capable of prolonged resistance to the abrasive action of solids or foreign matter contained in the liquid passing through the pump.
 - b. Casing designed to allow back pull-out of impeller.
 - c. Casing tested under a hydrostatic head of at least 75 psi or 150 percent of the rated shutoff head, whichever is greater.
 - d. High point of casing fitted with an air vent and the low point with a drain.
 - 3. Impeller:
 - a. Constructed of cast iron (ASTM A48 - Latest Rev.).
 - b. Enclosed, symmetrical, balanced type.
 - c. Vanes shall have smooth contours and well-rounded entrances.
 - d. Impeller hub shall NOT have ports which cause thrust reduction on the impeller.

- e. Keyseated and securely attached to shaft by a streamline locknut or equally efficient method, capable of withstanding a pump reversal to full runaway speed, but still permit easy removal.
- f. Clearance maintained by external shaft adjustment at outboard bearing.
- 4. Shaft:
 - a. Constructed of high grade, alloy forged steel or stainless steel and accurately machined.
 - b. Alloy steel shafts shall be protected from wear by removable stainless steel sleeve that extends through the mechanical seal and "O" ring gasket.
- 5. Seal:
 - a. The pump shaft seal shall be a John Crane Type 21 Carbon/ Ceramic/ Buna-n mechanical seal or equal.
- 6. Base:
 - a. The pump shall be mounted on a substantial, cast-iron pedestal base.
- 7. Couplings:
 - a. The pump motor shall be close coupled to the pump.
- 8. Wearing Rings:
 - a. Constructed of bronze.
 - b. Installed on the impeller and in the pump casing at the suction side.
 - c. Replaceable.
- 9. Main Frame:
 - a. Constructed of close-grain cast iron and bolted to the casing with machine-faced joints.
 - b. Designed to support the full weight of the pump and motor and to resist without distortion the stresses due to impeller thrust and bearing load.
- 10. Spare Parts:
 - a. Complete set of gaskets per pump.
 - b. Complete replacement pump shaft seal assembly including special container with complete installation instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. In accordance with Specification Section 11000.

3.2 START-UP AND TESTING

- A. In accordance with Specification Sections 01800 and 11000.

END OF SECTION

SECTION 11319ADRY PIT SUBMERSIBLE NON-CLOG CENTRIFUGAL PUMPSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish, install and test dry pit submersible non-clog centrifugal pumps, and all appurtenances necessary to make a complete and operable system as indicated in the Specifications and as shown on the Drawings.
- B. Related Work Specified Elsewhere (when applicable):
 - 1. Additional requirements are specified in Sections 01800, 11000 and 11310.
 - 2. General Requirements are specified Division 1.
 - 3. General Pump System Requirements and Pump Schedule are specified in Section 11310.
 - 4. Pipe, fittings and valves are specified in Division 15.
 - 5. Electrical is specified in Division 16.
- C. Performance Requirements: Each pump shall be capable of continuously pumping raw unscreened wastewater at all flow and head conditions indicated in the pump schedule, and along the pump curve. Before entering the wetwell, wastewater will normally pass through comminutors.

1.2 QUALITY ASSURANCE

- A. In accordance with the requirements of Section 11000.
- B. All system components specified herein shall be furnished by a single Manufacturer who regularly engages in the production of this type of equipment. The Manufacturer shall be responsible for the performance and warranty of the entire system provided under this section.
- C. Qualifications of Manufacturers: The Manufacturer shall have a minimum of 10 years of experience in the design and manufacture of the specified equipment. Products shall have proven reliable in similar installations over a reasonable number of years.
- D. Acceptable Manufacturer's:
 - 1. Sulzer/ABS Model XFP.
 - 2. No equivalent.

1.3 SUBMITTALS

- A. In accordance with the requirements specified in Section 01340, 11000 and 11310 and as specified herein. Submit such shop drawings, manufacturer's literature, short-term and long-term storage requirements, and operations and maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with the requirements of Section 11000. Manufacturer shall deliver equipment to the project site where and when directed by the Contractor.

1.5 WARRANTY

A. In accordance with the requirements of Section 11000.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. All pumps designated for a certain function shall be supplied by the same manufacturer.
2. All parts shall be designed and proportioned to have liberal strength, stability, and stiffness to perform required functions.
3. Exposed hardware shall be stainless steel.
4. Provide ample room and fittings for inspection, repairs and adjustments.
5. All openings and internal passages shall be large enough to permit the passage of 3 inch diameter sphere solids and any trash or stringy material which may pass through the average house collection system.

B. Pump Construction:

1. Major pump components shall be of gray cast iron, EN-GJL-250 (ASTM A-48, Class 35B) with smooth surfaces devoid of porosity or other irregularities. All exposed fasteners shall be of stainless steel, 1.4401 (AISI 316). All metal surfaces coming into contact with the pumped media (other than the stainless steel components) shall be protected by a factory applied spray coating of zinc phosphate primer followed by a high solids two-part epoxy paint finish on the exterior of the pump. The pump shall be equipped with an open lifting hoop suitable for attachment of standard chain fittings. The hoop shall be of ductile iron, EN-GJS-400-18 (ASTM A-536, Grade 60-40-18), and shall be rated to lift a minimum of four times the pump weight.
2. Sealing design for the pump/motor assembly shall incorporate machined surfaces fitted with Nitrile (Buna-N) rubber O-rings. Sealing will be the result of controlled compression of rubber O-rings in two planes of the sealing interface. Housing interfaces shall meet with metal-to-metal contact between machined surfaces, and sealing shall be accomplished without requiring a specific torque on the securing fasteners. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered equal. No secondary sealing compounds shall be required or used

C. Impeller:

1. The impeller shall be of gray cast iron, EN-GJL-250 (ASTM A-48, Class 35B). The impeller shall be of the semi-open, non-clogging, two-vane design. The impeller shall be capable of passing a minimum of 4.1 x 4.7 inch oblong solids. The impeller shall have a slip fit connection onto the motor shaft, driven by a shaft key, and shall be securely fastened to the shaft by a stainless steel screw. A positively engaged, ratcheting washer assembly shall prevent the screw from loosening. The head of the impeller screw shall be effectively recessed within the impeller bore to prevent disruption of the flow stream and loss of hydraulic efficiency. The impeller shall be dynamically balanced to the ISO 10816 standard to provide smooth, vibration-free operation.

D. Wear Plate:

1. The wear plate shall be of gray cast iron, EN-GJL-250 (ASTM A-48, Class 35B). The wear plate shall be designed with a smooth surface incorporating strategically placed intercepting slots on the side facing the impeller, to shred and force any stringy solids which attempt to become lodged between the impeller and wear plate outward from the impeller and through the pump discharge. The wear plate shall be mounted to the volute with four stainless steel securing screws and four stainless steel adjusting screws to permit close tolerance adjustment between the wear plate and impeller for maximum pump efficiency. Adjustment to allow for wear and restore peak pumping performance shall be easily accomplished using standard tools, and without requiring disassembly of the pump. The use of fixed or non-adjustable wear plates or rings, or systems that require disassembly of the pump or shimming of the impeller to facilitate adjustment, shall not be considered equal. The suction flange shall be integrated into the wear plate and its bolt holes shall be drilled and tapped to accept standard 12-inch ANSI class 125/150 flanged fittings.

E. Volute:

1. The pump volute shall be a single-piece, gray cast iron, EN-GJL-250 (ASTM A-48, Class 35B), non-concentric design with centerline discharge. Passages shall be smooth and large enough to pass any solids which may enter through the impeller. The discharge size shall be 12 inches. The discharge flange design shall permit attachment to standard ANSI and DIN flanges/appurtenances. The discharge flange shall be drilled to accept either 12 inch ANSI class 125/150 or metric DN300 flanged fittings. Proprietary or nonstandard flange dimensions shall not be considered acceptable. The minimum working pressure of the volute and pump assembly shall be 10 bar (145 psi).

F. Dry Pit Submersible Motor:

1. The Premium Efficiency motor shall meet efficiency standards in accordance with IEC 60034-30:2008, level IE3 and NEMA Premium. Motor rating tests shall be conducted in accordance with IEC 60034-2-1 requirements and shall be certified accurate and correct by a third party certifying agency.
2. The motor shall be housed in a watertight gray cast iron, EN-GJL-250 (ASTM A-48, Class 35B), enclosure, capable of continuous submerged operation underwater to a depth of 20 meters (65 feet) and shall have an IP68 protection rating. The motor shall be of the squirrel-cage induction design, NEMA type B. The copper stator windings shall be insulated with moisture resistant, Class H insulation material, rated for 180°C (356°F). The stator shall be press fitted into the stator housing. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing is unacceptable. The rotor bars and short circuit rings shall be made of cast aluminum.
3. The motor shall be designed for continuous duty. The maximum continuous temperature of the pumped liquid shall be 40 deg C (104 deg F), and intermittently up to 50 deg C (122 deg F). The motor shall be capable of handling up to 10 evenly spaced starts per hour without overheating. The

service factor (as defined by the NEMA MG1 standard) shall be 1.3. The motor shall have a voltage tolerance of +/- 10% from nominal, and a phase-to-phase voltage imbalance tolerance of 1%. The motor shall have a NEMA Class A temperature rise, providing cool operation under all operating conditions. The motor shall be FM approved for use in NEC Class I, Division I, Groups C & D hazardous locations. The surface temperature rating shall be T3C. The motor shall meet the requirements of NEMA MG1 Part 30 and 31 for operation on PWM type Variable Frequency Drives.

G. Closed Loop Cooling System:

1. The factory installed closed-loop cooling system shall be of steel, 1.0036 (ASTM A-570, Grade D), adequately designed to allow the motor to run continuously under full load while in an unsubmerged (dry-pit) or minimally submerged condition without the need for de-rating or reduced duty cycle. A cooling jacket shall surround the stator housing, and an environmentally safe nontoxic propylene glycol solution shall be circulated through the jacket by an axial flow circulating impeller attached to the main motor shaft. The coolant shall be pumped through an integrated heat exchanger in the base of the motor whenever the motor is running, allowing excess heat to be transferred to the process liquid. Cooling systems that circulate the pumped medium through the cooling jacket, or those that use a toxic cooling liquid shall not be acceptable. The use of external heat exchangers, fans, or the supply of supplemental cooling liquid shall not be required.

H. Thermal Protection:

1. Each phase of the motor shall contain a normally closed bi-metallic temperature monitor switch imbedded in the motor windings. These thermal switches shall be connected in series and set to open at 140 deg C +/- 5 deg C (284 deg F). They shall be connected to the control panel to provide a high stator temperature shutdown signal, and are used in conjunction with external motor overload protection.

I. Mechanical Seals:

1. Each pump shall be equipped with a triple seal system consisting of tandem mechanical shaft seals, plus a radial lip seal; providing three complete levels of sealing between the pump wet end and the motor. The mechanical seal system shall consist of two totally independent seal assemblies operating in a lubricant reservoir that hydro-dynamically lubricates the lapped seal faces at a constant rate. The mechanical seals shall be of nonproprietary design, and shall be manufactured by a major independent manufacturer specializing in the design and manufacture of mechanical seals. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary industrial duty solid silicon-carbide seal ring and one rotating industrial duty solid silicon-carbide seal ring. The stationary ring of the primary seal shall be installed in a seal holding plate of gray cast iron EN-GJL-250 (ASTM A-48, Class 35B). The seal holding plate shall be equipped with swirl disruption ribs to prevent abrasive material from prematurely wearing the seal plate. The upper, secondary seal unit, located between the lubricant chamber and the sensing chamber, shall contain one stationary industrial duty solid silicon-

carbide seal ring, and one rotating industrial duty solid silicon-carbide seal ring. Each seal interface shall be held in contact by its own spring system. A radial lip seal shall be positioned above the sensing chamber, preventing any liquid that accumulates in the sensing chamber from entering the lower bearing and motor. The seals shall not require routine maintenance, or adjustment, and shall not be dependent on the direction of rotation for proper sealing. Each pump shall be provided with a lubricant chamber for the shaft sealing system which shall provide superior heat transfer and maximum seal cooling. The lubricant chamber shall be designed to prevent overfilling, and to provide lubricant expansion capacity. The drain and inspection plug shall have a positive anti-leak seal, and shall be easily accessible from the outside of the pump. The seal system shall not rely upon the pumped media for lubrication and shall not be damaged when the pump is run dry. Lubricant in the chamber shall be environmentally safe nontoxic material.

J. Mechanical Seal Protection System:

1. The primary mechanical seal shall be protected from interference by particles in the wastewater, including fibrous materials, by an active Seal Protection System integrated into the impeller. The back side of the impeller shall be equipped with a sinusoidal cutting ring, forming a close clearance cutting system with the lower submersible motor housing or seal plate. This sinusoidal cutting ring shall spin with the pump impeller providing a minimum of 75 shearing actions per pump revolution. Large particles or fibrous material which attempt to lodge behind the impeller or wrap around the mechanical seal, shall be effectively sheared by the active cutting system into particles small enough to prevent interference with the mechanical seal. The Seal Protection System shall operate whenever the pump operates, and shall not require adjustment or maintenance in order to function. Submersible pump designs which do not incorporate an active cutting system to protect the primary mechanical seal shall not be considered acceptable for wastewater service.

K. Moisture Detection Probes:

1. The integrity of the mechanical seal system shall be continuously monitored during pump operation and standby time. An electrical probe shall be provided in a sensing chamber positioned above the mechanical seals for detecting the presence of water contamination within the chamber. The sensing chamber shall be oil-filled, and shall have a drain/inspection plug with a positive anti-leak seal which is easily accessible from the outside of the pump. A solid-state relay mounted in the pump control panel or in a separate enclosure shall send a low voltage, low amperage signal to the probe, continuously monitoring the conductivity of the liquid in the sensing chamber. If sufficient water enters the sensing chamber, the probe shall sense the increase in conductivity and signal the solid state relay in the control panel. This system shall provide an early warning of mechanical seal leakage, thereby preventing damage to the submersible motor, and allowing scheduled, rather than emergency, maintenance. Systems utilizing float switches or any other monitoring devices located in the stator housing rather than in a sensing chamber are not considered to be early warning systems, and shall not be considered equal.

2. Two additional moisture sensing probes shall be provided: one in the electrical connection chamber and one in the motor chamber. These probes shall send separate signals to the control panel.
- L. Shaft:
1. The pump shaft and motor shaft shall be an integral, one piece unit adequately designed to meet the maximum torque required at any normal start-up condition or operating point in the system. The shaft shall have a full shutoff head design safety factor of 1.7, and the maximum shaft deflection shall not exceed .05 mm (.002 inch) at the lower seal during normal pump operation. Each shaft shall be of stainless steel, 1.4021 (AISI 420), and shall have a polished finish with accurately machined shoulders to accommodate bearings, seals and impeller. Carbon steel, chrome plated, or multi-piece welded shafts shall not be considered adequate or equal.
- M. Bearings:
1. Each pump shaft shall rotate on high quality, permanently lubricated, greased bearings. The upper bearing shall be a cylindrical roller bearing. The upper bearing shall be electrically isolated from the bearing housing to prevent bearing damage from circulating currents when the pump is operated on a variable frequency drive. The lower bearings shall be a matched set of at least three heavy duty bearings; two angular contact ball bearings and one cylindrical roller bearing. All three lower bearings shall have identical outer race diameters to provide maximum bearing load capacity. Bearings shall be of sufficient size and properly spaced to transfer all radial and axial loads to the pump housing and minimize shaft deflection. L-10 bearing life shall be a minimum of 100,000 hours at flows ranging from Ω of BEP flow to 1Ω times BEP flow (BEP is best efficiency point). The bearings shall be manufactured by a major internationally known manufacturer of high quality bearings, and shall be stamped with the manufacturer's name and size designation on the race. Generic or unbranded bearings from other than major bearing manufacturers shall not be considered acceptable.
- N. Power Cable:
1. The power cables shall be sized according to NEC and CSA standards and shall be of sufficient length to reach the junction box without requiring splices. The outer jacket of the cable shall be of chlorinated polyethylene (CPE) and be oil, water, and UV resistant, capable of continuous submerged operation underwater to a depth of 65 feet.
- O. Cable Entry/Junction Chamber:
1. The cable entry design shall not require a specific torque to insure a watertight seal. The cable entry shall consist of cylindrical elastomer grommets, flanked by stainless steel washers. A cable cap incorporating a strain relief and bend radius limiter shall mount to the cable entry boss, compressing the grommet ID to the cable while the grommet OD seals against the bore of the cable entry. The junction chamber shall be isolated and sealed from the motor by means of sealing glands. Electrical connections between the power cables and motor leads shall be made via a compression or post type terminal board, allowing for easy disconnection and maintenance.

2.2 SURFACE PREPARATION AND SHOP COATINGS

A. In accordance with the requirements of Section 11000.

2.3 SPARE PARTS

A. In accordance with the requirements of Section 11000.

B. Provide the following spare parts:

1. One complete set of any special tools required to service the equipment.

PART 3 - EXECUTION

3.1 EXAMINATION, PREPARATION, AND INSTALLATION

A. In accordance with the requirements of Section 11000 and the manufacturer's written instructions.

3.2 START-UP AND TESTING

A. In accordance with the requirements of Section 01800 and 11000.

B. Manufacturer or Manufacturer's Representative shall demonstrate that manufacturer provided controls (i.e., seal fail, motor over temperature) function as per the manufacturers written requirements, prior to equipment being put into service.

3.3 CLEANING AND FIELD COATINGS

A. In accordance with the requirements of Section 11000.

3.4 TRAINING AND WARRANTY PERIOD SUPPORT

A. In accordance with the requirements of Section 01800.

END OF SECTION

SECTION 13410

INSTRUMENTATION AND PROCESS CONTROL GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. General Requirements and Definitions:

1. A single System Integrator (SI) shall furnish all services and equipment as specified herein and in the following Specification sections:

<u>Section</u>	<u>Title</u>
13440	Instruments
13441	Control Narratives
13442	Programmable Logic Controllers
13444	Control Panels
13445	Communications Network

2. The System Integrator (SI) provide all labor, materials, equipment, operations, methods, programming, configuration, and procedures as indicated in the Contract Documents to achieve a fully integrated and operational system.
3. All systems indicated in the Contract Documents shall mean all necessary supervision, labor, equipment and materials required to provide complete, properly integrated systems.
4. All hardware systems shall be adjusted, tested, inspected and optimized to the satisfaction of the Engineer and Owner prior to being turned over to the Owner.
5. The words "provide", "supply", "supply and install", "install", "furnish" or "furnish and install" shall mean a complete and properly functioning hardware installation performed by the System Integrator unless otherwise noted. The System Integrator shall design and coordinate the Instrumentation & Process Control system for proper operation with related equipment and materials furnished by others under other sections of these Specifications and with related existing equipment.
6. Refer to Civil, Mechanical, Instrumentation, and Electrical Drawings to coordinate material and equipment locations. Refer to the Process Drawings for locations and connection to primary instrumentation, control valves and process equipment. Refer to the Electrical Drawings for the location of transmitters, control stations, motor drives and centers, variable speed drives, control panels, wiring diagrams, network, and computer equipment.

B. Work Included:

1. Refer to Paragraph 1.1.A.1 for list of specifications.
2. Equipment Control:
 - a. Provide PLC programming, SCADA programming, and network configuration for equipment control or connection to control, status indication and alarm annunciation of equipment as shown in the

Instrumentation Drawings and described in Section 13441 – Control Loop Descriptions.

3. Application Development: Refer to Section 13441
4. Meetings:
 - a. The SI shall attend a Pre-Instrumentation meeting with the Contractor, Engineer, and others prior to the submission of any specifications.
 - b. The SI shall attend construction meetings as necessary to coordinate construction sequencing.
 - c. The SI shall attend SCADA meetings for SCADA screen development with Owner and Engineer. Refer 13443.
 - d. The Contractor and SI shall attend a separate construction meeting specifically dedicated for SCADA Testing to include types of test, responsibility and requirements, scheduling, coordination, verification of test results prior to witness testing by the Engineer/Owner, and testing notification requirements.
5. Miscellaneous:
 - a. Furnish and install all transducers, media converters, protocol converters, terminals, transformers, interposing or pilot relays (for both new and existing equipment), signal transmitters, signal splitters/boosters, intrinsic safety barriers, power supplies, power supply connections and other miscellaneous instrumentation required to make a complete system for new and existing equipment.
 - b. Furnish and install all vendor or manufacturer cables and appurtenances between primary instruments and the transmitters, receiving instruments or destination terminals. All methods, materials and supplies will meet the requirements of Division 16.
 - c. Furnish mounting hardware for each instrument. The System Integrator will provide information on the proper installation in accordance with the Manufacturer's requirements for each instrument and shall supervise the installation. Tubing, process taps and an isolation valve will be provided under Mechanical in Division 11 and 15. Coordinate the size and type of connection required. Refer to the Instrument Installation Detail Drawing in the Contract.
6. O&M Documentation:
 - a. Provide complete O&M documentation as listed under paragraph 1.4 and other related Division 13 specifications.
7. Demolition:
 - a. Remove and/or relocate existing equipment as indicated on the Drawings.
 - b. Deliver PLC, OIT, and communications equipment not reused to Owner.
8. Coordination:
 - a. Process Instrumentation and Process Control Systems will be provided under Division 11, where specified. The System Integrator shall coordinate with the instrumentation and control systems provided under these sections.

- c. Conduit and wiring (excluding integral or vendor furnished cables) shall be provided and tested under Division 16 and as shown on the Electrical Drawings.
 - d. The SI shall provide the drawings as specified in Section 13444 to be used by the Electrical Contractor as a wiring aid.
 - e. The SI shall coordinate with the Electrical Contractor to update all ISA S5.4 or equivalent loop diagrams with actual terminal and wire label information as required.
 - f. Provide manufacturer recommended installation and mounting requirements for each instrument to be connected to process equipment, piping or fittings requiring a process connection such as NPT taps, sample piping and process line insertion. The System Integrator will supervise and provide guidance on proper installation of instrumentation equipment. This shall include manufacturer's recommended mounting installation heights and locations for gas detection sensors, clearances for level sensors per manufacturer's blanking distance, etc.
- C. Related Work Specified Elsewhere:
- 1. Coordination is specified in Division 1.
 - 2. Manufacturer's control systems for process equipment are specified in Division 11.
 - 3. Control Valve Actuators are specified in Division 15.
 - 4. HVAC Control Systems are specified in 15604.
 - 5. Electrical Systems are specified in Division 16.
- D. Related Work by Others under this Contract:
- 1. Local control stations (including E-stops, local hand switches, speed pots, and local indicating lights) and equipment control panels (i.e. MCCs, VFDs), indicated on Electrical Drawings.
- E. Demonstration of Complete Instrumentation and Process Control System:
- 1. The Owner will assume no liability or responsibility for any portions of the installation under this Contract until they are demonstrated by the Contractor and accepted by the Engineer in writing. Final demonstrations shall be made only after the Engineer is satisfied that the work has been completed in accordance with the intent of the Contract Documents.
 - 2. After the Instrumentation and Process Control System is completed, and when directed by the Engineer, demonstrate the total system operation and make final adjustments to the system. If any system or piece of equipment within a system fails to function properly, rectify such defects or inadequacies and make a final demonstration as directed by the Engineer.
 - 3. Provide the services of authorized manufacturers' representatives to instruct the Owner's representatives in the proper operation of each partial or complete system installed under this Contract where noted.
 - 4. Pay all charges or fees, including the cost of any special test equipment, factory engineers, etc., necessary for the proper performance of the specified tests, demonstrations and instructions.
 - 5. All demonstrations and instructions referred to shall be scheduled at the convenience of the Engineer and the Owner and in no case shall be scheduled

without at least 72 hours written notice to the Engineer. Scheduling of testing and certification of equipment by the Engineer until all instrumentation and electrical equipment have been installed, calibrated including testing/transmitting of alarms, status, etc have been performed in the field in accordance with the Specifications. Once the systems have been tested in the field, the Contractor shall notify the Engineer a minimum of 72 hours before a formal startup and testing of each location. All testing of the equipment or system(s) shall be performed in a single contiguous block of testing dates or as agreed upon by the Engineer.

6. Service calls:
 - a. Provide system integrator services of "insert number of days here" 8-hour working day (not including travel time) upon request of the Owner within the first year of operation. Unused time shall be issued to the Owner as a credit.

F. Removals, Relocations and Rearrangements:

1. Examine the existing site for the work of all trades, which will influence the cost of the work under Division 13. This work shall include removals, relocations and rearrangements relating to the work of all trades which may interfere with, disturb or complicate the performance of the work under Division 13; and relating to the work involving systems, equipment and related service lines which shall continue to be utilized as part of the finished project.
2. Provide in the bid a sufficient amount effort to include all removals, relocations, rearrangements and reconnections herein specified, necessary or required to provide approved operation and coordination of the combined new and existing systems and equipment.

1.2 QUALITY ASSURANCE

- A. All materials provided under this Contract shall be equal in quality, appearance and performance to that specified herein and shall be subject to the approval of the Engineer. Verify the availability of all materials proposed to be used in the execution of the work prior to submitting same for the Engineer's approval. Supply chain issues or the discontinuance of production of any material or product after approval has been granted shall not relieve the Contractor from furnishing an Engineer approved alternate of comparable quality, function, and design without additional cost.
- B. Materials and equipment furnished under this Contract shall be standard products of manufacturers regularly engaged in manufacture of such products and shall be manufacturer's latest standard design that complies with Specification requirements. Products shall essentially duplicate material and equipment that have been in satisfactory local use at least three years.
- C. Materials and equipment with any chipset furnished under this Contract shall be purchased and supported by the manufacturer or by an authorized manufacturer's representative.
 1. A certificate of authenticity or manufacturers manifest shall be provided at Engineers request.
- D. Material and equipment furnished under this Contract shall disallowed for use by any applicable government agency (E.g. EPA, DHS, etc) for use with critical infrastructure (E.g. the National Defense Authorization Act of 2018 banned the use

of Hikvision).

- E. The Contractor shall have supplied comparable systems to those specified herein and shall maintain engineering and service departments capable of designing and maintaining these systems. Provide for a period of 12 months from the date of final acceptance of the work, all necessary supervision, labor, materials, and equipment, in order to correct any defects in any system due to faulty materials, equipment, installation methods, or workmanship and consequent damage resulting from such defects. This work shall be scheduled during normal working hours and at the convenience of the Owner.
- F. System Integrator:
 - 1. The Contractor's attention is directed to the fact that the instrumentation is an integrated system and as such, shall be furnished by one supplier, who shall provide all of the equipment and appurtenances regardless of manufacturer, and be responsible to the Contractor for satisfactory operation of the entire system provided. Substitutions on functions specified will not be acceptable.
 - 2. The exception shall be where instrumentation and control packages are furnished by respective equipment manufacturers as required in Division 11, 14, 15, and 16. All necessary provisions will be made to ensure a proper signal and communication interface as indicated on the P&IDs and associated equipment specifications between the main process instrumentation and control packages specified within this section and those provided. The Contractor shall provide startup reports which demonstrate proper operation of Division 11, 14, 15, and 16 equipment and associated Division 11 control systems.
- G. Acceptable System Integrators:
 - 1. NIC Systems Corp., Cromwell, CT
 - 2. Aaron Associates, Waterbury, CT
 - 3. Electrical Installations Inc., Moultonborough, NH
 - 4. Or equal, having a minimum of 5 years' experience in supplying comparable systems.

1.3 SUBMITTALS TO THE ENGINEER

- A. Shop Drawings and Samples:
 - 1. Submit Shop Drawings and O&Ms in accordance with General Conditions Section 01340 and as indicated herein.
 - 2. Shop Drawings shall consist of:
 - a. Project name and location
 - b. Contractor's name
 - c. Index Sheet - Listing the equipment being submitted utilizing equipment designations, or symbols, indicated on the Contract Documents together with the proposed manufacturer, style/type and catalog number. The .pdf shall also have integral bookmarks.
 - d. Manufacturer's scale or dimensioned drawings along with standard catalog number.
 - e. Equipment ratings, service clearances and configuration.
 - f. Listing of accessories to be furnished

- g. Panel wiring diagrams showing the location of each mounted component, front panel elevation(s), internal wiring diagram of each component including terminal numbers.
- h. Bill-of-Material Table showing a complete listing of the components in each control panel. Table shall include separate columns for the following: Item Number, Quantity, Manufacturer, Part number, Description, Designator Tag, Supplier name and phone number.
- i. ISA S5.4 loop diagrams or equivalent showing point to point wiring for all instrumentation equipment including terminal numbers. Prior to final completion, update the above drawings with wire labels and terminals provided by the Electrical Subcontractor. Refer to Section 13444 for additional information.
- j. SAT Report:
 - i. The SI shall furnish an I/O checkout sheet identifying and acknowledging that field wiring is properly terminated to the SI furnished hardware.
 - ii. The SI shall furnish a checklist of all the instruments that have been configured and ready for additional testing.
 - iii. The SI shall furnish a checklist of all of the PLC, SCADA, network, and security functions that have been tested.
- k. SCADA screens, OIT screens, and database tags.
- l. Refer to the other Division 13 Sections for additional shop requirements.
- 3. All material shall be contained in one submission; partial submissions will not be accepted.
- 4. Submissions shall be in the form and quantity indicated in the General Conditions. Each equipment type shall be separated by index tabs with typewritten titles.
- 5. Provide samples of programs, graphics, etc., within 10 days upon receipt of request from the Engineer.
- B. Maintain properly documented and witnessed test and checkout reports and submit these to the Engineer. No form of energy shall be applied to any part of the instrumentation system prior to receipt by the Engineer, from the Contractor, of the supplier's certified statement of approval of the installation and containing his authorization to energize the system, except that the supplier's serviceman may do so for the purpose of check-out as described herein.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Coordinate material and equipment delivery with the project schedule. Notify the Engineer immediately, in writing, if material or equipment delivery will adversely affect the project schedule, include documentation from equipment suppliers indicating the revised delivery dates and the reason for the delay.
- B. Coordinate delivery of equipment directly to other vendors where instrumentation supplied under this section has to be installed in panels supplied under other specification sections.
- C. Exercise care during loading, transporting, unloading and handling of materials to prevent damage.
- D. Check for defective or damaged materials, and for incomplete equipment shipments

within seven days after equipment delivery to the project site.

- E. Store materials and equipment on the construction site in enclosures or under protective covering in order to assure that materials and equipment are kept undamaged, clean and dry. The Contractor shall maintain an inventory of instruments and control panels received on site and store in a safe, secure, dry and temperature-controlled location. This inventory shall be made available to the Engineer upon request.
- F. Replace or repair, to the satisfaction of the Engineer, all materials and equipment that are defective or that have been damaged during installation, at no additional cost to the Owner.

1.5 O&M REQUIREMENTS:

- A. Provide the Owner with a list of local service departments of duly authorized distributors of materials and equipment of the type installed, which will stock the manufacturer's standard parts, etc. The list may be included on the bill-of-materials.
- B. At the completion of the installation, provide Record Drawings on sheets no less than 11" x 17", indicating the final configuration of all systems as they were installed. Symbols, equipment designations, instrument ISA designations, etc., shall be consistent with the Contract Documents. Provide exact locations of all work which has been concealed in concrete, masonry or underground. The following diagrams shall be included:
 - 1. Control Panel diagrams on 11" by 17" sheet showing the front face and panel mounted equipment with full listing of components including names, descriptions and model numbers for each component. One copy of the panel diagrams will be laminated for insertion into the pocket inside each control panel.
 - 2. Point to Point terminal wiring diagrams for all field instruments, motor starters, equipment drives, valve actuators and other field equipment connected to the control system. When called out provide diagrams meeting ISA S5.4 standards requirements for loop diagrams on 8½" by 11" sheets, showing one loop per sheet. Drawings shall reflect as built conditions.
 - 3. Panel wiring diagrams showing the location of each mounted component; front panel elevation(s) and name plates; internal wiring diagram of each component including field instruments and terminal numbers; and network communications including all provided equipment, on 11" by 17" sheets.
 - 4. Network diagrams on 11" x 17" format. Refer to Section 13444 for additional requirements.
 - 5. Provide a hardcopy set of applicable drawings in each control panel and one binder with a hardcopy of all record drawings.
 - 6. Provide a copy of all record drawings to the Owner and Engineer in AutoCAD DWG format or Adobe PDF format on a USB drive. .pdfs shall have integral bookmarks denoting all sections and subsections. USB drive shall be clearly labeled.
- C. Refer to the other Division 13 Sections for additional O&M requirements.
- D. O&M Manual Organization:

1. O&M's shall be organized to be easily navigable. Devices shall be arranged by group and type. Example, all flow meters will be grouped together and arranged so that mag meters are together, than thermal mass meters, etc.
2. The hardcopy operations and maintenance manuals shall be organized in three ring binders with a maximum size of 4". The following is a proposed outline for the O&M Manual(s), provide applicable Sections:

TITLE

Table of Contents

Section 1 - Reserved for description of system by Owner

Section 2 - Field Instruments (arranged by device group and type, ex. Flow meters, submersible level, floats, etc.)

2.1 ISA instrument calibration data sheets and instrumentation listing with part numbers

2.2 O&M literature for each type of instrument with labeled dividers

2.3 Instrument configuration data

Section 3 - Panel Equipment (arranged device type)

3.1 Bill-of-Material Table

3.2 O&M and Manufacturer's literature

Section 4 - Miscellaneous devices (arranged alphabetically by manufacturer)

4.1 Bill-of-Material Table

4.2 O&M and Manufacturer's literature

Section 5 - Drawings

5.1 Network drawings

5.2 Panel fabrication and assembly drawings

5.3 Panel wiring diagrams

5.4 Interconnection wiring diagrams

5.5 ISA S5.4 loop diagrams

Section 6 - PLC

6.1 CPU, memory capacity, communication ports

6.2 Rack Layout and module configuration

6.3 I/O List

6.4 PLC communication parameters/ port configuration

Section 7 - Miscellaneous Data

7.1 Data Networking Equipment List

7.2 Data Networking Equipment Configuration, IP Addresses, Layout, and Security Access.

Section 8 - Software programs and PDF Literature

8.1 PLC Programming Software

8.2 OIT Programming Software

Section 9 - Program

9.1 PLC Program in native format with data tag registers, cross reference list, and comments.

9.2 PID parameter printouts (per loop)

9.3 OIT programs in native format with screen color Printouts, communication configuration, and data tag printout.

- 9.4 Custom Report Printouts
- 9.5 Alarm Configuration and alarm tag printouts.

E. The cover and edge of each volume shall contain the following information:

Old Norwich Road Pump Station
Waterford Utility Commission

Instrumentation and Control System
Operations and Maintenance Manual
Specification Section 13###
Volume X of Y

(where X is the volume number and Y is the number of volumes)
Subcontractor Name, Date

- F. Electronic O&M Information:
 - 1. Supply all electronic files on 4.8 GB DVD-R media or USB drive
 - a. .PDFs shall be bookmarked by order of O&M.
 - b. Scanned .PDFs shall not be accepted.
 - 2. Refer to other Division 13 specifications for additional information.
- G. Warranty Documentation: The Contractor and System Integrator shall investigate, diagnose, repair, update and distribute all pertaining documentation of deficiencies which become evident during the warranty period. All such documentation shall be submitted to the Engineer within 30 days of solving the problem.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

- 1. All of the equipment shall be the manufacturer's latest proven design. If a piece of equipment was sole sourced, but is no longer the current version, the SI shall propose and carry the latest version of the product migration path. Specifications and Drawings call attention to certain features, but do not purport to cover all details entering into the design of the instrumentation and process control system. The completed system and the equipment furnished by the Contractor shall be compatible with the functions required.
- 2. Components shall be finished to the manufacturer's standard for the service intended unless otherwise indicated in the Specifications or on the Drawings.
- 3. All electrical components of the system shall operate on 120-volt, single-phase, 60-Hertz current, except as otherwise noted in the specifications and drawings. Power shall be supplied from either local electrical distribution panels, or an associated control panel UPS with breakers for each circuit as indicated on the Instrumentation and Electrical drawings.
- 4. All controls for electrically operated or motor-driven equipment (including electrically actuated valves, small pumps and chemical feed equipment, etc.) shall be complete, including all necessary auxiliary relays, so as to require only

wiring and connections to the equipment control circuit. All contacts for control of motor-operated or electrically operated equipment shall be rated not less than 10 amperes on 120 volts unless otherwise specified herein.

5. Panel components including switches, relays, instrumentation, etc. supplied by the various process equipment manufacturers, but indicated to be installed within panels furnished by the System Integrator, shall be furnished to the System Integrator for incorporation into his panels. Equipment shall be installed to the manufacturers requirements and recommendations. System Integrator shall install these items within his panel and shall produce a complete, functional, pre-wired system for installation requiring only external power and instrumentation connections. The Contractor shall coordinate this requirement and shall ensure that equipment manufacturers provide all necessary installation instructions and requirements to the System Integrator.
6. Identification:
 - a. All panels, and control devices shall have identifying nameplates. Equal quality nameplates shall be attached to all field-installed units.
 - b. Each field transmitter shall have an attached manufacturer's tag with the Manufacturer's name, model number, serial number, power requirements, and scaled range of the instrument.
 - c. Provide suitable lamicoid labels for each process measurement element and transmitter. Label will identify each medium being measured, range and units of measurement and indicating transmitter/element ID No., for example:

Station Flow
0.00 to 2,500 GPM
FIT-240

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. The Specifications and Drawings do not attempt to fully indicate the degree of assembly, subassembly, shipped condition, extent of field work, or degree of accuracy required to install the equipment or materials. The Contractor shall be required to rely on his prior experience or to otherwise inform himself of the amount of field work required to assemble, erect, and install the equipment or material, as received, to produce a finished installation ready for use or operation.
2. All equipment installed as part of the work shall be positioned, assembled, aligned, doweled, and otherwise set to the tolerances required by the equipment manufacturer. Where tolerances and methods are not specifically indicated, they shall be in accordance with best millwright practice.
3. All materials incorporated in the work shall be installed in accordance with the Drawings and Specifications. Where detailed drawings or technical specifications are not provided, the materials shall be installed in accordance with the manufacturer's preferred recommendations and conforming to the best

practice of the trade involved. Installation shall include all accessories required to produce a completed installation ready for use.

4. The Owner will assume no liability or responsibility for any portions of the installation under this Contract until they are demonstrated and accepted in writing. Final demonstrations shall be made only after the Owner and Engineer are satisfied that the work has been completed in accordance with the intent of the Contract Documents.
 5. Sensors or instrumentation to be installed shall be provided with sufficient cable length and mounting configuration for easy removal, service, and replacement. The service of the instrument shall not require its wiring removed or disconnected. Any instrument found deficient in this area shall be reconfigured by the Contractor as approved by the Engineer at no additional cost to the Owner or Engineer. Refer to instrumentation details or submit an RFI prior to procurement, submittal, and/or installation.
- B. Electrical Work:
1. All electrical work shall conform to the requirements indicated in Division 16.
- C. Procedures Prior to Startup:
1. The Contractor and System Integrator shall:
 - a. The SI shall be onsite during VFD and MCC startup and configuration to verify proper connection and scaling to the control panel using PLC program.
 - b. All wiring will be installed, terminated, and tested by the Contractor in each control panel. Wire labeling shall be coordinated between the SI and the Electrical Contractor during construction to assign terminal numbers in loop drawings of all field terminations, including intermediate junction boxes. Refer to Section 16010.
 - c. Calibrate and configure all Division 13 supplied instrumentation as specified in Section 13440.
 - i. Verify that each instrument is properly installed, configured, and is properly measuring values for the application.
 - ii. Shall ensure that the control system scaling matches the instrument scaling.
 - iii. Provide digital averaging/filtering or any other advanced configuration where required for proper equipment control. This “filtered” engineering process signal used for process control shall accurately track and represent the original engineering process signal without “turbulence”, “signal delay” or “signal droop”.
 - iv. Configure all instruments to fail in the safest condition for the specific application. Example, a wastewater pump station with backup floats should have the analog level measurement fail low and a water plant finish water chlorine instrument should fail to a value to shut the facility down.
 - d. Coordinate with Division 11 control panel manufacturers in establishing network communications as required on the Drawings. If the Division 11 provided PLC’s communication protocol does not match that of the PLC being provided by the Division 13 System Integrator, the System

Integrator shall provide a protocol converter as specified in Section 13445.

- e. Verify the facility installation.
- f. Be onsite during Equipment Startup to verify equipment wiring and basic functionality of Division 13 furnished equipment.
- g. Coordinate and verify interface with electrical equipment, including field wiring terminations.
- h. Document hardware configuration and wiring information.
- i. Configure all furnished network equipment unless otherwise specified.
- j. Demonstrate network functionality.

2. The Contractor and SI shall:

- a. Coordinate with Division 11 control panel manufacturers in establishing network communications as required on the Drawings, and the signals required in Section 13441. The Division 11 control panel manufacturer shall coordinate communication and programming requirements with the SI prior to programming effort. Any programming and network configuration changes shall be done to provide network communication shall be provided at no cost to the Engineer and Owner.
- b. Prior to the witnessed site acceptance testing, the SI shall perform a preliminary test to verify operation prior to witnessed testing. The Contractor shall assist as necessary.
- c. Perform and IO checkout from field device to PLC prior to any automated and PLC testing.
 - i. The SI shall monitor and manipulate the PLC inputs and outputs through the PLC program.
 - ii. The Contractor, Electrical Contractor will assist the SI with testing IO from devices. The individual(s) assisting with checkout shall be qualified to do the required testing.
- d. Coordinate VFD interface and scaling.

D. Site Acceptance Testing

- 1. A Site Acceptance Test shall be performed on each Division 13 control system after the installation at each site to verify that each instrument and equipment drive is connected properly to the control panel and that all functions of the control panel are operating as specified.
 - a. The Contractor shall schedule Startup and SAT activities with the Engineer at least 5 business day in advance.
 - b. The Contractor shall not schedule more than 3 days of site acceptance testing, or training during any week without agreement from the Engineer and Owner. No site acceptance testing shall occur on Fridays without agreement from the Engineer and Owner.
 - c. Additional SAT activities restrictions may be determined by the Owner.
- 2. The Contractor and SI shall:
 - a. Verify the facility installation.
 - b. Demonstrate proper instrument configuration.
 - c. Provide final instrument field calibration sheet/documentation after SAT has been completed.

- d. Verify accuracy of documentation, operator's manuals, software documentation, and site operating instructions, etc. after SAT has been completed. Documentation shall include all field modifications.
 - e. Troubleshoot and correct any hardware deficiencies, including, but not exclusive to communications issue.
 - f. Be available during the Site Acceptance Test to correct any hardware deficiencies and/or adjust instrument configurations as necessary.
3. The Contractor and SI shall:
- a. The SI will be responsible for all PLC, OIT, and SCADA programming. The Contractor will be responsible for all hardware and equipment unless otherwise specifically stated.
 - b. Demonstrate each functional requirement identified by the Specification.
 - c. Demonstrate all equipment control functions, including the operation of automatic control strategies. Actuation of field devices and operation of equipment shall be closely coordinated with Engineer and Owner's staff.
 - d. Demonstrate all networking functionality.
 - e. Verify system performance parameters and system responses under field operational conditions.
 - f. Demonstrate all equipment control functions, including the operation of automatic control strategies. Actuation of field devices and operation of equipment shall be closely coordinated with Engineer and Owner's staff.
 - g. Demonstrate that the parameters for each PID operation in the PLC provide a smooth responsive transition without over oscillation with a sudden change in the process value or set point. PID parameters will be determined, verified, and demonstrated with PID tuning software that displays trending of the process variable, controlled variable, and set point over time.
 - h. Provide digital averaging/filtering or any other advanced configuration where required for proper equipment control.
 - i. Verify system performance parameters and system responses under field operational conditions.
 - j. Verify accuracy of documentation, especially operator's manuals, software documentation, and site operating instructions. Documentation shall include all field modifications.
 - k. Provide completed site acceptance testing (SAT) test documentation. Including:
 - i. Startup reports
 - ii. Initial startup values
4. The SAT will be observed by the Engineer and/or Owner's representative.
- E. Refer to Section 01800 for additional startup, testing, training requirements for the instrumentation equipment.

END OF SECTION

SECTION 13440INSTRUMENTATION AND PROCESS CONTROLPART 1 - GENERAL1.1 DESCRIPTIONA. Work Included:1. Field Instruments:

- a. Furnish and install the instrumentation as shown on the Drawings and listed in the Instrumentation Schedule at the end of this Section. The locations of the instruments are shown on the Process and Electrical Drawings.
- b. Instruments shall be installed in accordance with the Drawings and as indicated in the Manufacturer's installation manuals. Any deviation in instrumentation or electrical installation requirements for the supplied equipment shall be provided at no additional cost to the Owner.
- c. Provide support as necessary during Site Acceptance Testing to adjust the configuration of field instruments (E.g. signal dampening, ranges, echo suppression, etc.). Refer also to Section 13410.
- d. Provide ISA sheets and instrument configuration documentation after acceptance testing.

2. Miscellaneous:

- a. Furnish and install all transducers, media converters, protocol converters, terminals, transformers, interposing or pilot relays (for both new and existing equipment), signal transmitters, signal splitters/boosters, intrinsic safety barriers, power supplies, power supply connections and other miscellaneous instrumentation required to make a complete system.
- b. Furnish and install all vendor or manufacturer cables and appurtenances between primary instruments and the transmitters, receiving instruments or destination terminals with sufficient service loop. Manufacturer cables between elements and transmitters shall not be spliced without prior engineer approval. All methods, materials and supplies will meet the requirements of Division 16.
- c. Furnish mounting hardware for each instrument. The System Integrator will provide information on the proper installation in accordance with the Manufacturer's requirements for each instrument and shall supervise the installation. Tubing, process taps, and an isolation valve will be provided under Mechanical in Division 11 and 15 unless otherwise specified. Coordinate the size and type of connection required. Refer to the Instrument Installation Detail Drawing in the Contract.

3. Acceptance Testing:

- a. Refer to Section 13410 for additional requirements.

- b. O&M Documentation:
 - i. Provide complete O&M documentation as listed in Specification 13410, including:
 - (1) Final ISA S20 instrument data sheets (or equivalent) with updated calibration data. The ISA instrument datasheet shall be representative of the latest version. If the calibration and configuration data is on the instrument configuration sheets, the calibration and configuration data does not need to be replicated.
 - (2) Instrument configuration sheets (often seen in the appendixes of the instrument manuals). Configuration sheets shall be completed with all non-default values.
- 4. Coordination:
 - b. Provide manufacturer recommended installation and mounting requirements for each instrument to be connected to process equipment, piping or fittings requiring a process connection such as NPT taps, sample piping and process line insertion. The System Integrator will supervise and provide guidance on proper installation of instrumentation equipment. This shall include manufacturer's recommended mounting installation requirements (clearances for level sensors per manufacturer's blanking distance, etc.) Refer to the execution requirements below for additional installation requirements.
- B. Related Work Specified Elsewhere:

Section	Title
13410	Instrumentation and Control General
13441	Control Loop Descriptions
13442	Programmable Logic Controllers
13444	Control Panels
13445	Communications Network

1.2 QUALITY ASSURANCE

- A. Materials and equipment furnished under this Contract shall be standard products of manufacturers regularly engaged in manufacture of such products and shall be manufacturer's latest standard design that complies with Specification requirements. Products shall essentially duplicate material and equipment that have been in satisfactory local use at least three years.

1.3 SUBMITTALS TO THE ENGINEER

- A. Shop Drawings and Samples:
 - 1. Submit Shop Drawings and O&Ms in accordance with General Conditions Section 01340, 13410, and as indicated herein.
 - a. Manufacturer's scale or dimensioned drawings along with standard catalog number. Catalog number shall be written on any cutsheet that has an extensive part number or highlighted.
 - b. Equipment ratings, service clearances and configuration.

- c. Listing of accessories to be furnished
- d. ISA Instrument Sheets (or equivalent)
- 2. All material shall be contained in one submission; partial submissions will not be accepted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

- 1. Refer to Section 13410.

B. Instrumentation Equipment (Refer to Instrumentation Schedule at the end of this Section)

1. **Magnetic Flow Meters and Indicating Transmitters: FE/FIT**

- a. Provide electromagnetic type flow meters, as indicated in the Instrumentation Schedule, with the following requirements.
- b. Transmitter:
 - i. Type: Remote Wall Mount
 - ii. Display: Backlit LCD
 - iii. Power: 120 VAC
 - iv. Accuracy: Minimum 0.50% of rate above 1 ft/s fluid velocity
 - v. Analog Output: 4 to 20 mA DC
 - vi. Operating Temperature: -4 to 150 °F
 - vii. Electrical Connections: ½" NPT
 - viii. Enclosure Rating: NEMA 4X
 - ix. Communications Protocol: None
 - x. Memory: Non-volatile
 - xi. Measuring Range: Per Instrumentation Schedule
- c. Measuring Element:
 - i. Type: Flange Style flow tube for continuous flow measurement
 - ii. Applications:
 - (1) Raw Wastewater
 - iii. Materials:
 - (1) Housing & Flanges: Carbon Steel with painted corrosion resistant coating
 - (2) Measuring tube: 304 Stainless Steel
 - (3) Liner: Hard Rubber
 - (4) Measuring Electrodes: Hastelloy C
 - iv. Ground Reference: Stainless Steel Ground Rings
 - v. Operating Temperature: -20 to 350 °F
 - vi. Operating Pressure: Max 215 psi
 - vii. Electrical Connection: ½" NPT
 - viii. Process Connection: ANSI Class 150 Flange
 - ix. Size: Per Instrumentation Schedule
 - x. Enclosure Rating: Per Instrumentation Schedule

- d. Accessories and Spare Parts:
 - i. One ductile iron pipe spool piece with the same flange to flange dimension as the magnetic flow meter to replace the meter during maintenance (one for each pipe size). Paint spool pieces per Painting - Section 09900.
 - ii. Grounding electrodes.
 - e. For Flow Tubes mounted in Class I, Div. 1/2 area the entire flow meter system shall be rated for that classification and carry the required Factory Mutual approval. Refer to Instrumentation Schedule for required flow tube enclosure rating.
 - f. The PLC shall use a counting function, in conjunction with the transmitter pulse output, to totalize flow through the flow meter. The pulse output shall close the circuit each time a configurable volume passes through the flow tube. The pulse output shall be configurable through the flow meter transmitter.
 - g. Equivalent to:
 - i. Flow Tubes:
 - (1) Class I, Div. 2: Flow Tube: Krohne Enviromag 2000, Krohne Optiflux 2000 Series, or Equal
 - (2) Class I, Div. 1: Flow Tube: Yokogawa ADMAG AXF, Rosemont 8705 or 8732 (E5 option), Siemens Sitrans Mag 3100 with 6000I ex or Equal
 - ii. Transmitters:
 - (1) Siemens Sitrans Mag 5100
 - (2) Endress & Hauser Promag 50W
 - (3) Rosemont E-Series
 - (4) Yokogawa ADMAG Series
 - (5) Krohne IFC-300 Series
 - (6) Or Equal
2. **Submersible Level Transducer and Transmitter: LE/LT**
- a. Provide submersible pressure transducers, as indicated in the Instrumentation Schedule, with the following requirements.
 - b. Transmitter:
 - i. Type: Submersible with Integral Pressure Measuring Element
 - ii. Power: 24 VDC Loop Power
 - iii. Accuracy: 0.25% full span
 - iv. Analog Output: 4 to 20 mA DC
 - v. Enclosure Rating: NEMA 6P
 - vi. Communications Protocol: None
 - vii. Measuring Range: Per Instrumentation Schedule
 - c. Measuring Element:
 - i. Type: Submersible Elastomeric Diaphragm Pressure Sensor
 - ii. Applications:
 - (1) Pretreated Wastewater

- (2) Liquid Primary and Secondary Sludge
 - (3) Wastewater Final Effluent
- iii. Materials:
 - (1) Housing: Stainless Steel or PVC
 - (2) Diaphragm: Teflon
 - (3) Cable: Teflon or Polyurethane
 - (4) Cable Gland: Viton
 - (5) Measuring Cell Fluid Fill: Silicone Oil
- iv. Diaphragm: Minimum 0.89" diameter non clogging
- v. Operating Temperature: 32 to 122 °F (compensated over entire temperature range)
- vi. Burst Pressure: 2X Full Span
- vii. Atmospheric Pressure Reference: Atmospheric reference tube with aneroid bellows breather system.
- viii. Lightning Protection: Full Lightning Protection
- d. Accessories and Spare Parts:
 - i. Provide a stainless-steel mounting rack with an adjustable cable stop for each submersible pressure transducer.
- e. Power and signal cable shall be a factory-attached watertight cable with stiffeners to allow the sensor to be freely supported by the cable. Cable length shall be sufficient to extend from the transmitter to closest junction box plus an additional 6 ft.
- f. Transducers that are mounted in a Class I, Div. 1/2 designated areas shall be intrinsically safe and be protected by a suitable intrinsically safe barrier. Refer to Instrumentation Schedule for hazardous area requirements.
- g. The cable will be extended to a NEMA 4X junction box, provided by Division 13. The signal cable shall be spliced in the junction box, per manufacturer's recommendations, and extended to the respective control panel. Atmospheric reference tube shall be terminated in the junction box per manufacturers recommendations.
- i. Mounting
 - i. Provide a 12-inch-long section of 316 stainless steel pipe, $\frac{3}{4}$ to 1-inch diameter with NPT threads to mount to the transducer. The transducer and pipe shall be suspended using a stainless-steel PVC coated cable with stainless steel clamps and bolts with friction nuts.
 - ii. Submersible pressure transducers that are 2-inch in diameter or smaller shall be installed in a stilling well. Stilling well shall be constructed of 3-4" PVC and suspended from the wall of the wetwell by stainless steel pipe clamps.
 - iii. The measuring face of the field instrument shall be located approximately 6" above the tank finished floor.
- j. Equivalent to:

- i. KPSI Model 705
 - ii. Siemens Model A1000i
 - iii. Contegra Model SLX130
 - iv. Or equal
- 3. **Float Type Level Switches (for Intrinsically Safe circuits): LSL, LSL, LSH, LSHH**
 - a. Provide a float switch, as indicated in the Instrumentation Schedule, with the following requirements. A non-mercury float switch shall be provided with non-oxidizing contacts to allow low DC voltage signals for use with intrinsic safety devices.
 - b. Float Switch
 - i. Type: Narrow angle float switch
 - ii. Applications:
 - (1) Raw Waste Water
 - iii. Materials: Polypropylene float
 - iv. Operating Temperature: 32 to 140 °F
 - v. Float Rating: Submersible
 - vi. Cable:
 - (1) Water resistant
 - (2) Oil Resistant
 - vii. Switch Contacts:
 - (1) Non-oxidizing
 - (3) 0.1 amps at 125 VAC or 30 VDC
 - (4) Non-mercury mechanically activated
 - c. Accessories and Spare Parts:
 - i. Open Tanks or Channels:
 - (1) Provide a stainless steel mounting rack with an adjustable cable stop for each float switch.
 - (2) External weight set for setting float switch activation angle.
 - (3) Wall mountable clamp for setting float switch activation level and angle
 - d. Class I, Div. 1/2 Installations:
 - i. Float switches that are mounted in a Class I, Div. 1/2 designated areas shall be intrinsically safe and be protected by a suitable intrinsically safe barrier.
 - ii. Float switch cables will terminate in a junction box rated for Class I, Div. 1/2 areas as required by the installation. The gas tight seal, required when transitioning between hazardous and non-hazardous areas, will be installed after the junction box. The manufactured cable will be spliced in the junction box and extend to the respective control panel.
 - e. Refer to Instrumentation Schedule for hazardous area requirements. Equivalent to:

- i. Milliampmaster Control Switch by SJE Rhombus
 - ii. 9G-EF Float Switch by Siemens
 - iii. SNF-52 Series by MDI
 - iv. Eco-Float Gold by Anchor Scientific
 - v. or equal
- 4. **Temperature Element and Indicating Transmitter: TE/TIT**
 - a. Provide an industrial temperature element with transmitter, as indicated in the Instrumentation Schedule, with the following requirements.
 - b. Transmitter:
 - i. Type: Wall mountable temperature transmitter for degrees F.
 - ii. Display: 7 Segment LCD
 - iii. Power: 24 VDC Loop
 - iv. Accuracy: +/- 1.0 °F
 - v. Analog Output: 4 to 20 mA DC
 - vi. Enclosure Materials: Coated aluminum
 - vii. Operating Temperature: 32 to 95 °F
 - viii. Electrical Connections: ½" NPT
 - ix. Enclosure Rating: NEMA 4X, IP67
 - x. Communications Protocol: None
 - c. Temperature Element:
 - i. Type: 100 ohm, 3 wire Platinum Sensor
 - ii. Applications:
 - (1) Ambient Air
 - d. Mounting: Wall mount with bracket kit.
 - e. Class I, Div. 1/2 Installations:
 - i. Temperature transmitters that are mounted in a Class I, Div. 1/2 designated areas shall be intrinsically safe.
 - f. Equivalent to:
 - i. Devar Inc. RTI-EC
 - ii. Or Equal
- 5. **Fuel Level: LE/LT**
 - a. Provide a float style continuous level sensor with integral transmitter, as indicated in the Instrumentation Schedule, with the following requirements.
 - b. Transmitter:
 - i. Type: Continuous 4-20ma float style no local display
 - ii. Display: None
 - iii. Power: 24 VDC Loop Power
 - iv. Accuracy: 0.25% full span
 - v. Analog Output: 4 to 20 mA DC
 - vi. Enclosure Materials: 316 Stainless Steel
 - vii. Wetted Parts: Float: Buna-N or Stainless, Balance: 316 stainless
 - viii. Operating Temperature: -20 to +120 °F
 - ix. Electrical Connections: ½" NPT

- x. Temperature Compensation: Internal
- xi. Enclosure Rating: NEMA 4X / IP67
- xii. Communications Protocol: None
- xiii. Memory: Non-volatile
- xiv. Configuration: Factory Calibrated
- xv. Type: Float Style
- xvi. Applications:
 - (1) Level Measurement:
 - (a) Fuel Oil
- xvii. Measuring Range: Per Instrumentation Schedule
- c. Mounting:
 - i. Storage Tanks:
 - (1) 3" NPT Pipe
 - (2) Bulkhead Fitting
- d. Transducers that are mounted in Class I, Div. 1/2 designated areas shall either be explosion proof or intrinsically safe and shall carry the required Factory Mutual approval. Non intrinsically safe instruments shall be protected by a suitable intrinsically safe barrier. Refer to Instrumentation Schedule for hazardous area requirements.
- e. Equivalent to:
 - i. Madison C4651-12804
 - ii. Or Equal
- 6. **Low Profile Level Switch: LSH**
 - a. Provide a low profile encapsulated level switch, as indicated in the Instrumentation Schedule, with the following requirements.
 - b. Level Switch:
 - i. Type: Single point float activated magnetic reed switch.
 - ii. Applications:
 - (1) Chemical Area Containment Sumps
 - (2) Pump Station Flood Alarms
 - iii. Materials: Polypropylene or PVDF
 - (1) Chemically resistant to the following:
 - (a) Acids
 - (b) Bases
 - (c) Sodium Hypochlorite
 - (d) Sodium/Magnesium Hydroxide
 - (e) Ferric/Ferrous Chloride
 - (f) Sodium Bisulfite
 - iv. Switch Contacts:
 - (1) Hermetically sealed
 - (2) SPST
 - (3) 0.4 Amps at 120 VAC or 24 VDC
 - v. Operating Temperature: 32 to 150 °F
 - vi. Process Connection: 1/8" NPT

- c. Accessories and Spare Parts:
 - i. None
 - d. Equivalent to:
 - i. Gems LS-3
 - ii. Dwyer
 - iii. Or Equal
7. **Level Indicator: LI**
- a. Provide a level indicator, per Instrumentation Schedule, with the following requirements:
 - b. Level Indicator:
 - i. Type: LED digital indicator
 - ii. Display:
 - (1) 1.20 inch numeric characters
 - (2) Single line
 - (3) 4 digit
 - (4) Digital Format: 4 digit Display
 - iii. Power: 120 VAC
 - iv. Accuracy: 0.1% full span
 - v. Analog Input: 4 to 20 mA DC
 - vi. Analog Output:
 - (1) 4 to 20 mA DC
 - (2) 700 Ohm loop resistance at 24 VDC
 - vii. Discrete Output:
 - (1) (2) SPDT relay individually configurable
 - (2) Contact Rating: 3A at 120 VAC or 24 VDC
 - viii. Operating Temperature: -40 to 150 °F
 - ix. Enclosure Rating: NEMA 4X, IP65
 - x. Memory: Non-volatile
 - xi. Units: Per Instrumentation Schedule
 - xii. Mounting: Front panel mount
 - c. Accessories and Spare Parts:
 - i. None
 - d. Equivalent to:
 - i. Precision Digital Trident Model PD765
 - ii. Devar 3019
 - iii. Foxboro
 - iv. Or Equal
8. **Pressure Transmitter for (Level Measurement: LE/LT or Pressure: PE/PT)**
- a. Provide a pressure transducer with integral transmitter, as indicated in the Instrumentation Schedule, for use in measuring liquid level with the following requirements.

- b. Provide a pressure transducer with integral transmitter, as indicated in the Instrumentation Schedule, for use in measuring line pressure with the following requirements.
- c. Transmitter:
 - i. Type: Continuous gauge pressure
 - ii. Display: Blind
 - iii. Power: 24 VDC Loop
 - iv. Accuracy: 0.25%
 - v. Analog Output: 4 to 20 mA DC
 - vi. Enclosure Rating: NEMA 4X, IP65
 - vii. Operating Temperature: -4 to 185 °F
 - viii. Electrical Connection: ½" NPT
 - ix. Communications Protocol: None
 - x. Measuring Range: Per Instrumentation Schedule
- d. Measuring Element:
 - i. Type: Diaphragm actuated strain gauge
 - ii. Applications:
 - (1) City Water
 - iii. Materials:
 - (1) Housing: Stainless Steel
 - (2) Diaphragm: Stainless Steel
 - iv. Operating Temperature: -4 to 185 °F (compensated over entire temperature range)
 - v. Burst Pressure: 3X Full Span
 - vi. Process Connection: ¼" NPT
- e. Accessories and Spare Parts:
 - i. Process Isolator:
 - (1) Provide a wafer style pressure isolation flange to isolate the pressure switch from the process fluids.
 - (a) The flange shall be constructed of shop painted carbon steel flange meeting ANSI B16.5 Class 150 standards.
 - (b) The pressure shall be transferred from an elastomeric ring embedded around the inside diameter of the flange to a ¼" NPT port on the outside of the flange.
 - (c) The pressure switch and diaphragm seal shall be factory assembled. Filling the oil reservoir in the field will not be acceptable.
- f. Instruments mounted in Class I, Div. 1/2 shall be intrinsically safe and carry the required Factory Mutual approval. Refer to Instrumentation Schedule for hazardous area requirements.
- g. Equivalent to:
 - i. Ashcroft Model A4
 - ii. United Electric Controls TX200B
 - iii. KPSI 27 Series

- iv. Or Approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. The Specifications and Drawings do not attempt to fully indicate the degree of assembly, subassembly, shipped condition, extent of field work, or degree of accuracy required to install the equipment or materials. The Contractor shall be required to rely on their prior experience or to otherwise inform himself of the amount of field work required to assemble, erect, and install the equipment or material, as received, to produce a finished installation ready for use or operation.
2. All equipment installed as part of the work shall be positioned, assembled, aligned, doweled, and otherwise set to the tolerances required by the equipment manufacturer. Where tolerances and methods are not specifically indicated, they shall be in accordance with best millwright practice.
3. All materials incorporated in the work shall be installed in accordance with the Drawings and Specifications. Where detailed drawings or technical specifications are not provided, the materials shall be installed in accordance with the manufacturer's preferred recommendations and conforming to the best practice of the trade involved. Installation shall include all accessories required to produce a completed installation ready for use.
4. Sensors or instrumentation to be installed shall be provided with sufficient cable length and mounting configuration for easy removal, service, and replacement. The service of the instrument shall not require its wiring removed or disconnected. Any instrument found deficient in this area shall be reconfigured by the Contractor as approved by the Engineer at no additional cost to the Owner or Engineer. Refer to instrumentation details or submit an RFI prior to procurement, submittal, and/or installation.

B. Electrical Work:

1. All electrical work shall conform to the requirements indicated in Division 16.

C. Field Calibration:

1. All instrumentation shall be calibrated in the presence of the Engineer.
2. All flow and level transmitters shall be factory calibrated and set up to the extent possible at the factory. Span, range, and operating parameter adjustment shall be made at the factory or in the field by a factory trained personnel. Each system shall meet the manufacturer's standard accuracy.
3. Analyzing instruments shall be field calibrated by a factory-trained engineer or technician using procedures recommended by the manufacturer. Provide all materials required for proper calibration. Calibration shall be done in the presence of the Engineer.
4. Secondary functions such as alarm actuations and pacing shall be adjusted during initial calibration and demonstrated after the system is placed in service.

Range adjustments shall be sealed by colored lacquer in the presence of the Engineer immediately following calibration.

5. Process calibration, such as volumetric drawdown tests on flows and level measurements, shall be conducted on all measuring systems as requested by the Engineer.
6. Refer to Section 01800 for startup, testing, training requirements for the instrumentation equipment.

INSTRUMENTATION SCHEDULE

TAG	TYPE/SIZE	DESCRIPTION	LOCATION	RANGE	UNITS	SERVICE	POWER	P&ID	SPEC. SECTION
TE/TIT-250A,250B	RTD	Temperature Sensor	Pump Station Monitoring	20-120	Deg F	NEMA 4X	24 VDC Loop	I-3	13440 2.1 B.4
FE/FIT-240	MAG/ 14"	Mag Meter	Flow Meter	0-2,500	GPM	Sensor: NEMA 4X X-mitter: NEMA 4X	120VAC	I-3	13440 2.1 B.1
LSHH, LSL-221,222	FLT	Level Switch	Wetwell Level	-	-	NEMA 6P	30 VDC Loop	I-3	13440 2.1 B.3
LE/LT-221,222	SUB	Level Element/Transmitter	Wetwell Level	0-15	Feet	NEMA 6P	24 VDC Loop	I-3	13440 2.1 B.2
LE-200	FLT	Level Element	Generator Diesel Fuel Tank Level	0-300	Gal.	Sensor:C1D1	120VAC	I-3	13440 2.1 B.5
LSH-250A	FLT	Level Switch	Pump Station Monitoring	-	-	NEMA 6P	24 VDC Loop	I-3	13440 2.1 B.6
LI-221,222	-	Level Display	Wetwell Level	0-15	Feet	NEMA 4X	120VAC	I-3	13440 2.1 B.7
PE/PIT-250	PRS	Pressure	Pump Station Monitoring	0-120	psi	NEMA 4X	24 VDC Loop	I-3	13440 2.1 B.8

INSTRUMENT ABBREVIATION LEGEND

MAG – Electro Magnetic Flow Meter	SUB – Submersible Level Transducer	TURB – Turbidity	RTD- Resistance Thermal Diode
FLT – Float	PRS – Pressure	ULT -- Ultrasonic	

END OF SECTION

SECTION 13441

CONTROL LOOP DESCRIPTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes control descriptions for loop diagrams shown on the Instrumentation Drawings for:
 - i. Old Norwich Road Rump Station
- B. At a minimum, all status, alarm, and control signals shown on the drawings shall be provided as such and in accordance with the CONTROL DESCRIPTIONS - GENERAL part whether explicitly called out or not.
- C. The specific requirements of the custom software will be defined during the Shop Drawing submittal process, with the input of the Owner and Engineer. A meeting(s) will be held at the project site, with a representative of the System Integrator, PLC Programmer/Supplier, Client, Contractor, and Engineer, to finalize the custom programming specifications.
- D. Related Sections:
 - 1. Section 13410 – Instrumentation and Process Control General
 - 2. Section 13440 – Instrumentation and Process Control
 - 3. Section 13442 – Programmable Logic Controllers
 - 4. Section 13444 – Control Panels
 - 5. Section 13445 – Communication Network

1.2 SYSTEM DESCRIPTION

- A. Provide instrumentation hardware, software and programming as necessary to perform control functions specified herein and as shown on drawings. Ensure coordination with other work to ensure that necessary wiring, conduits, contacts, relays, converters, and incidentals are provided in order to transmit, receive, and control necessary signals to other control elements, to control panels, and to receiving stations.
- B. The specifications direct attention to certain required features of the system, but do not purport to cover all details entering into its design and construction. Nevertheless, the Contractor shall furnish the CONTROL LOOPS complete in all details and ready for operation.

1.3 SUBMITTALS

- A. Operation and Maintenance Manuals:
 - 1. Provide annotated final versions of the modified PLC, operator interface terminal and SCADA programming files on USB.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 CONTROL DESCRIPTIONS – GENERAL

- A. Operator Interface Terminal (OIT) software will be used for process monitoring and control as noted in the specific control loop descriptions. OIT/SCADA screens shall be constructed in accordance with the following general requirements:
 - 1. Process Overview Screen showing status and location of each process related field instrument and process equipment in relation to the Process and Instrumentation Diagrams (P&ID). Operators shall be able to access more detailed screens for equipment control, process control setpoints and time delays, mode control, alarm history, and alarm setpoints and time delays.
 - 2. Process Equipment Control Screens: Screens and pop-up displays shall be provided for process equipment monitoring, equipment control, and operating parameters/setpoints and delay timer adjustment.
 - 3. Alarm Summary and Alarm Set-up Screens: Screens shall be provided to display active alarms, entry of alarm setpoint values and delay timer settings, and enable/disable alarms. The screens shall also include capability to acknowledge and reset alarms.
 - 4. Graphical symbols shall be used to represent each piece of process equipment and field instrument. Equipment symbols that are used shall be representative of each piece of equipment displayed. Instrument symbols shall be in accordance with ISA S5.1 standards and Instrument Drawing I-1.
 - a. Refer to Instrumentation Drawing I-1 “Indicator Light Color Legend” for light color convention.
 - b. Display the status and process values for all equipment in the system.
 - c. Refer to the Instrument Schedule in Section 13440 for all process value scaling and ranges.
 - 5. Skeuomorphism shall be used as a design theme as required for quickly familiarizing the operator with the functionality.
 - 6. Alarm History Screen: A screen shall be provided to display all active and past alarms. The operator shall also be able to acknowledge and reset alarms from this screen.
 - 7. Provide an alarm banner on each OIT/SCADA screen that displays at a minimum the last three alarm conditions. Active alarms shall flash in red. Acknowledged alarms shall be “solid” red.
 - 8. Process Variable Historical Trends shall include the following:
 - a. Screens shall be provided to display historical trends of all process variables with adjustable scale and units.
 - b. The operator shall be able to add and delete pens as necessary and load and save pen groups to form analytical groups of data.
 - c. Trends shall be configured to minimize space on hard drive by updating on change only.
- B. All process, operational and alarm setpoints and associated delay-timer setpoints will be adjustable through the OIT/SCADA screens and will be generated and controlled at each respective PLC.
- C. All Control Loop programming shall be done in the PLC where the inputs/outputs terminate unless otherwise stated. All PLC tags shall be descriptive in nature.

D. Equipment Fail Alarms:

1. Equipment Fail alarms are defined as a condition where a command is given and the status confirmation of that command is not received within an acceptable time-frame. Fail Alarms shall not be triggered in the event of Loss of Power, or any other alarms related to the equipment (ie. High Temp, O/L. Fault, Low Pressure, etc.). Examples are as follows:
 - a. Fail to start-stop: A piece of equipment is given the command to start and the running status is not confirmed within an appropriate time delay. Conversely a piece of equipment is commanded to stop and the run status does not drop out within an appropriate time delay.
 - b. Fail to open-close: A duty valve is given the command to open and the opened status is not received within an appropriate time delay. Conversely, a duty valve is given the command to close and the closed status is not received within an appropriate time delay.
 - c. Fail to make speed: A VFD driven piece of equipment is commanded to go to a specific speed and it does not reach that speed (within a deadband) within an appropriate time delay.
 - d. Fail to make position: A modulating control valve is commanded to go to a specific position and it does not reach that position (within a bandwidth) within an appropriate time delay.
2. Provide the applicable Equipment Fail alarms for all equipment based on type and I/O available.

E. PID Controllers:

1. The words "PID", "PID Control" "PID Controller" shall mean a control loop feedback mechanism that is a complete function for the described process control and which includes operator adjustable inputs for fine tuning. These terms do not purport to require a prescribed method but to describe a universal function for feedback control. Nevertheless, the Contractor shall furnish a means to control the process smoothly and accurately, complete in all details, using standard good practices, and ready for operation.
2. The PID controller algorithm parameters DEADBAND, GAIN (Proportional), DELAY, RESET (Integral), REPEATS (Derivative), Loop Update Time, and MINIMUM/MAXIMUM Controller Output shall be adjustable through a password protected screen (accessible at the OIT/SCADA).
3. Each PID controller shall have a faceplate configured with numeric and graphic indication of setpoint, process variable and controller output, AUTO/MAN mode selection (as applicable), means of setpoint entry, and navigation button to access a historical display screen with the setpoint, process variable, and controller output.
4. Process Values and Setpoints shall be scaled from the true engineering range to the required PID range as necessary to provide the full resolution in the calculation of error.
5. The setpoint shall be limited to prevent hazardous process conditions. Range shall be hardcoded in the OIT/SCADA during startup and commissioning.
6. Loop update time of the feedback control shall be coordinated with the analog input module and the requirements of the process.

7. Unless otherwise noted, PID controller outputs are 0 to 100%, linearly scaled to a 4 to 20 mA DC output signal by the PLC.
 8. Each PID controller shall be configured for bumpless transfer with anti-windup and anti-reset when switching between manual (or hand) and automatic modes.
 9. Each PID controller shall be configured for Bumpless Restart when the controller changes from Program to Run mode or when the controller powers up.
 10. Control Value (CV) Clip and Clamp: The PID controller output shall be compared with an adjustable low limit (0% unless otherwise noted) and an adjustable high limit (100% unless otherwise noted). The PID controller output signal will not be lower than the low limit (clamp) or greater than the high limit (clip). If the PID algorithm calculates an output that is out of range, then the PID algorithm shall cease accumulating error for the integral term until the calculated output is back in range.
 11. If an alternative algorithm to PID is used, the method that is provided shall include equivalent requirements.
 12. Where PID or equal is required, additional provisions shall be made for the control loop to function as described.
- F. Where specifically noted in the loop descriptions software Hand/Off/Auto and On/Off selector switches shall be forced to the OFF position under certain interlock logic conditions so that an energized run output from the PLC is de-energized. This will require an operator to manually restart the equipment or to place the equipment in AUTO to allow for automatic operation. The H/O/A selector shall not be enabled in the HAND or AUTO positions until the condition causing the forced placement to the OFF position has returned to normal.
- G. In the event of an instrument or process analyzer failing or loss of signal, the PLC shall utilize last known value as not to upset the process condition/control. An alarm shall be generated as “loss of signal” for that particular instrument/analyzer. If associated with a PID loop, the PID loop shall be automatically placed in manual mode with bumpless transfer and anti-windup/anti-reset.
- H. All SCADA Servers, View Nodes, and PLC’s shall time sync once a day. A single SCADA Server shall time sync with the NIST server. A Firewall exception policy shall be created to allow for the specific address and protocol.
- I. Control Loops
1. Local LOR/HOA – all local hardware selector switches shall:
 - a. In Local or Hand position run the associated equipment to be used in conjunction with Open-Stop-Close pushbuttons or a potentiometer for valve position or VFD speed.
 - b. In Off position, Stop the associated equipment
 - c. In Remote or Auto position, the control of the associated equipment shall be transferred to the PLC. At the OIT/SCADA the operator shall control the equipment with either a software HOA or both a software HOA and an OSC. The OIT/SCADA system will display the “In Remote” and “Not in Remote” status based on an auxiliary contact in the Remote position. This status shall be displayed near the software selector switch. The same shall apply for “Auto” and “E-stop”.

2. Software HOA – all OIT/SCADA software selector switches shall:
 - a. In Hand position Run the associated equipment in manual mode whereby an operator can make adjustments with setpoint entry.
 - b. In Off position, Stop the associated equipment from running remotely.
 - c. In Remote or Auto, the control of the associated equipment shall be transferred to PLC control as described in the control loop.
 - d. Related alarms such as Not in Remote, E-Stop, etc. shall be displayed as statuses at the LOR/HOA controls or with the equipment status.
3. Pressing Close will latch the Close command until a Full Close or 0% Open is received
4. Historical Trends –
 - a. All analog and digital signals shall be available at SCADA.
5. Flow Totalizing –
 - a. All flow meters shall be configured in PLC for flow totalizing with display at OIT/SCADA.
 - b. Flow totals shall be configured as both running totals with a password protected (or higher user privilege) reset and with a separate pushbutton resettable total.
 - c. Systems with more than one flow meter will also have a combined flow totalizer in the same style.
 - d. Flow meters from other divisions shall be displayed and totalized similarly.
6. Runtime Hours Totalizing –
 - a. All equipment with a Run Status signal shall be configured in the PLC for run hour totalizing with display at OIT/SCADA.
 - b. Runtime Hour totals shall be configured as both running totals with a password protected (or higher user privilege) reset and with a separate pushbutton resettable total.
7. Analog Alarms – shall be configured at the OIT/SCADA with the following (operator adjustable):
 - a. Low and High Setpoints
 - b. Low Low and High High Setpoints as specified in specific loops below.
 - c. Delays – Alarm shall activate if the setpoint is reached for this adjustable time period, (0-60 seconds, initially 5s).
 - d. Ability to Enable/Disable the alarm with a button.
 - e. All alarms shall be latched upon activation and reset with the Alarm Acknowledge pushbutton.
8. Digital Alarms – all alarms noted as such or as other (fault, overload, fail, E-Stop, etc.) on drawings as shall be configured at the OIT/SCADA with the following (operator adjustable):
 - a. Delays – Alarm shall activate if TRUE for this adjustable time period, (0-60 seconds, initially 5s).
 - b. Ability to Enable/Disable the alarm with a button.
 - c. All alarms shall be latched upon activation and reset with the Alarm Acknowledge pushbutton.

9. Alarm Dialing – Alarms proceeded with a “^” in the control narratives shall not be initially set up to dial out through the alarm dialer. Owner / Engineer to reserve the right to ask for the alarms to be added at a later date and/or other alarms to be removed at no additional cost to owner.
 10. Security – Alarms or Setpoint with a “@” in the control narratives shall only be able to be changed by a supervisor or administrator.
 11. Timer modes – Any control that requires a duration setpoint shall include a countdown displayed value to indicate to the operator the length of time until the mode expires.
 12. Totalizer mode – Any control that requires a totalized setpoint shall include a current total displayed value to indicate to the operator the current progress towards the setpoint.
 13. PLC Failure Mode – Upon PLC failure, all discrete outputs shall de-energize to an off condition.
- J. Emergency Standby Power:
1. The System Integrator shall provide programming of time delays to stagger restarting of equipment and loads (to be finalized during construction).
- K. Reading/Writing across the Network– Provisions shall be made such that multiple points of access have the ability to change setpoints and modes. This functionality shall be furnished such the setpoint or command will automatically reset and the operator does not have to intervene. The setpoint or command shall change to a value that does not have control in the system once the required change is made.

3.2 CONTROL LOOP DESCRIPTIONS

- A. Loop 020 (Pump Control Panel)
1. General: Seven status lights on the face of the Pump Control Panel provide an indication of panel status. The PLC generates four latching alarms that illuminate lights on the face of the panel. A Reset pushbutton on the panel or at the OIT/SCADA shall unlatch the alarms.
 2. Local Monitoring/Control
 - a. Pump Control Panel Instruments
 - i. Normal Power Indicator Light (YL-020A)
 - ii. On UPS Power Indicator Light (YL-020B)
 - iii. Common Alarm indicator Light (YA-020A)
 - iv. PLC Fail Alarm Indicator Light (YA-020B)
 - v. Reset Pushbutton (HS-020)
 - vi. Power Failure (ESL-020)
 - vii. UPS Failure (YA-020C)
 - b. The Normal Power indicator light (YL-020A) shall be illuminated, and a power fail control relay shall be energized when the control panel is powered by the control power.
 - c. When control power is lost, and the control panel is powered by the UPS the power fail control relay will de-energize which will close a set of contacts to illuminate the On UPS Power indicator light (YL-020B).
 3. PLC Functions

- a. The PLC shall monitor the power failure contact and shall activate the Control Panel Power Fail alarm if an adjustable on-delay timer expires (0 - 600 seconds, initially 60 seconds).
 - b. The PLC shall output a common alarm if any of the alarms configured in the PLC program are active. This common alarm output shall activate the Common Alarm light on the panel (YA-020A).
 - c. The PLC shall de-energize a discrete output with relay contacts, one normally open held closed and another normally closed held open to drive the PLC Fail alarm light on the panel (YA-020B).
 - d. The contact state of the reset pushbutton (HS-020) shall be monitored by the PLC. When pushed, the PLC shall unlatch the PLC Fail and Common Alarm if the alarm condition has returned to normal. Additional contacts are provided to unlatch hardwired alarm signals
- 4. Alarms at OIT/SCADA
 - a. Power Fail Alarm
 - b. Common Alarm
 - c. UPS Failure Alarm
 - d. PLC Fault
- 5. Monitoring/Status/Control at OIT/SCADA
 - a. Reset Pushbutton
- B. Loop 240- Station Flow Monitoring
 - 1. General: The pump station flow rate is measured using a magnetic flow meter. The scaling for the flow rate signal is provided below.
 - 2. Local Monitoring/Control
 - a. Local indication of flow rate at FIT-240
 - 3. PLC Functions
 - a. Input: AI, flow rate (4 - 20 mA DC scaled to 0.0 – 2,500GPM).
 - b. Flow Total Calculation: A resettable and a cumulative flow total shall be calculated from the flow rate. For each PLC scan, the flow total will be calculated as follows:

$$\text{Flow total (MG)} = \{(\text{flow rate}) \div (60 \times 10^6)\} \times (\text{PLC scan time}), \text{ where flow rate is in gpm and PLC scan time is in seconds}$$

As far as practical, the PLC scan time should be fixed for this calculation. Alternatively, the scan time between successive calculations shall be computed and used in the calculation.
- 4. Alarms at OIT/SCADA
 - a. None
- 5. Monitoring/Status/Control at OIT/SCADA
 - a. Flow Rate indication and trend (no trend at OIT)
 - b. Flow Total indications (0.00 - 99.99MGD)
- C. Loops 210 & 211 – Comminutors
 - 1. General: Comminutor run status is indicated, A comminutor failure alarm is annunciated.

2. Local Monitoring/Control
 - a. Existing control at the comminutor control panels.
3. PLC Functions
 - a. Input: DI (XA-210, -211, Comminutor Failure)
 - b. Input: DI (YI-210, -211, Comminutor Running)
4. Alarms at OIT/SCADA
 - a. Comminutor Failure
5. Monitoring/Status/Control at OIT/SCADA
 - a. Comminutor Run
- D. Loops 221 & 222- Wet Well Level Monitoring and Control
 1. General: Wet well level is measured by submersible level transmitter measurement system. Wet well level is used for automatic control of the wet well pumps. Float switches in the wet well are used for level alarm annunciation and for backup level control.
 2. Hard Wired Interlocks with Backup Control (HS-###B) Enabled:
 - a. LSSL-### in conjunction with HS-###A (WW1/WW2/Both) shall provide a hard wired shutdown of all running pumps per the selected wet well(s).
 - b. LSHH-### in conjunction with HS-###A (WW1/WW2/Both) shall provide a hard wired start of all pumps per the selected wet well(s).
 3. Local Monitoring/Control
 - a. Pump Control Panel
 - (1) A Wet Well selector switch HS-221B, -222B allows an operator to select the pumps used in backup level control. The selections are Pumps 1 & 2; Pumps 2 & 3; Pumps 3 & 1. A pump must be in AUTO mode if backup level control is desired (see Loops 230,231 and 232).
 - (2) A Backup Level Control On indicating light YL-221, -222 is located at the Pump Control Panel and is illuminated when pumps are called to operate from the float switches. A discrete input for the PLC is provided for indication at the OIT that backup level control is on.
 - (3) A hard-wired control circuit in the Pump Control Panel will operate two pumps if the selected wet well high-high level and low-low level float switch are activated, if pumps have been selected for backup level control, and the selected pumps are in AUTO mode. A schematic of the control circuit is found in the Instrumentation Drawings.
 - (4) If backup level control is activated and at least one pump is running, a control relay in the backup level control circuit is energized. This relay contact YY-220A is wired to the alarm telemetry system.
 4. PLC Functions
 - a. Inputs
 - (1) AI Wet Well 1 level LT-222 4 - 20 mA DC scaled to 0.0 – 10.0 feet),

- (2) DI (qty. 2): Wet Well 1, Wet Well 2 High-High Level LSHH-221, LSHH-222 , LSHH shall be installed so that the NO contact closes when wet well level exceeds EL 116.
 - (3) DI (qty.2): Wet Well 1, Wet Well 2 Low-Low Level (detected by, respectively, field instruments LSL-221 ,LSL-222(Old Norwich Road)). LSL shall be installed so that the NO contact is open when wet well level is below EL 111.50.
 - (4) DI: Backup Level Control enabled
- b. The proposed measuring range and level alarm setpoints are as follows:

	Old Norwich Road
	Level (ft.)
Highest Measured Level	11.5
High-High Level Alarm	10.0
High Level Alarm	9.0
Low Level Alarm	3.0
Low-Low Level Alarm	2.0
0 Depth	0.00

- c. Automatic Wet Well Level Control
- (1) Pump start and stop control is based on wet well level. In AUTO mode, the Lead and Lag pumps run when level exceeds the associated start setpoint. The pump(s) shall continue to run until level drops below the associated stop setpoint. See also Loops 230, 231 and 232. The proposed pump start/stop control setpoints are as noted below.

	Old Norwich Road
	Level (ft.)
Lag Pump Start	8.0
Lead Pump Start	7.0
Lag Pump Stop	5.0

Lead Pump Stop	4.0
----------------	-----

- (2) Pump speed control is based on wet well level. In AUTO mode, a proportional band algorithm is used to compute the pump speed command signal. The proportional band algorithm parameters, corresponding to maximum and minimum pump speed configuration, for pump speed control are noted below. All pumps are commanded to run at the same speed. See also Loops 230, 231 and 232.

		Old Norwich Road	
		Level (ft.)	Speed (%)
Maximum Pump Speed		7.0	100.0
Minimum Pump Speed		5.0	50.0

5. Alarms at OIT/SCADA
 - a. High-High Level
 - b. High-Level
 - c. Low Level
 - d. Low-Low Level
 - e. Backup float control active
 - f. Level alarm setpoints and timer settings
 6. Monitoring/Status/Control at OIT/SCADA
 - a. Level indication
 - b. Pump start/stop control setpoints
 - c. Backup Level Control Enabled
- E. Loops 230,231 232(– Raw Sewage Pumps
1. General: The raw sewage pumps can be operated in manual or in automatic mode. In automatic mode, operation is based on wet well level.
 2. Local Monitoring/Control
 - a. Division 16 furnished E-Stop pushbutton (HS-##B) is located near the motor. If an E-Stop is activated, a hard-wired interlock in the pump control circuit in the PCP prevents the pump from running (refer to the pump control schematic in the Instrumentation Drawings). An auxiliary contact on each E-Stop pushbutton is wired to PLC I/O.
 - b. The Division 13 furnished local Pump Control Panel (PCP) contains the following:
 - (1) Hand/Off/Auto Selector Switch (HS-##A): When the H/O/A

selector switch is in the HAND position, the equipment will run, and pump speed is adjusted at a manual loading station (HSC-##). When the selector switch is in the OFF position, the equipment will not run. When the selector switch is in the AUTO position, automatic control in PLC logic is enabled.

- (2) Run Indicating Light (YL-##C)
- (3) Motor High Temperature Alarm Light (TAH-##)
- (4) Moisture Alarm Light (MAH-##)
- (5) Torque Alarm Light (MAHH-##)
- (6) Reset Pushbutton (HS-##D)
- c. PCP Control Circuit Interlocks
 - (1) The control circuit contains a hard-wired interlock to shut down the equipment when the E-Stop (HS-###B) is activated. The interlock is latching and is un-latched by returning the E-Stop pushbutton to the normal position.
 - (2) The control circuit contains a hard-wired interlock to shut down the equipment on a motor high temperature condition (TSH-###). The interlock is latching and is un-latched using the reset pushbutton at the PCP.
 - (3) The control circuit contains a hard-wired interlock to shut down the equipment on a high torque condition (WSHH-###). The interlock is latching and is un-latched using the reset pushbutton at the PCP.
- 3. VFD Monitoring/Control
 - a. The VFD contains the following:
 - (1) VFD Keypad (SIC-##)
 - (2) Run/Stop Indicating Lights (YL-##A, YL-##B)
 - (3) Elapsed Runtime Meter (KQI-##)
 - (4) VFD Fault Alarm Light (YA-##)
- 4. PLC Functions
 - a. Inputs/Outputs
 - (1) DI: H/O/A selector switch in AUTO
 - (2) DI: Run status
 - (3) DI: VFD fault
 - (4) DI: Motor high temperature
 - (5) DI: Moisture high
 - (6) DI: E-Stop activated
 - (7) DI: Torque Alarm
 - (8) DI: Surge buster valve open
 - (9) DO: Start command
 - (10) AI: Speed (4 to 20 mA DC scaled 0.0 to 100.0%)
 - (11) AI: Ampere Draw (4 to 20 mA DC scaled 0.0 to 150.0)
 - (12) AO: Speed Command (0.0 to 100.0% scaled 4 to 20 mA DC)
 - b. Automatic Operation
 - (1) Automatic Operation Logic: Equipment operation is

- controlled by start/stop commands and a speed command generated by the logic of Loop 120.
- (2) A service selection table will be provided at OIT/SCADA screens so that each piece of equipment can be selected as Lead or Lag as long as its H/O/A selector switch is in the AUTO position. With unique service selections made, the "AUTO ALT." option activated, and a SERVICE or TIME basis selected at the OIT/SCADA, then the equipment is alternated in the service designations as follows:
 - (1) If SERVICE basis is selected, the pumps shall be alternated in the service positions after the completion of an operating cycle: an operating cycle is begun when the Lead equipment is called to start and ends when the Lead equipment is called to stop. The Lead pump shall become the Lag pump and vice versa. The Standby Pump is not listed but will be called to start if either the lead or lag pump fail or are offline.
 - (2) If TIME basis is selected, the pumps shall be alternated in the service positions, as noted above, after an on-delay timer expires. The on-delay timer shall have a range of 1 hour to 7 days.
 - c. Equipment Protection and Process Interlock Logic
 - (1) In automatic mode, the PLC DO start command shall be disabled when there is an Emergency Stop, VFD Fault, Motor High Temperature, High Torque, or Run Failure condition. The PLC DO command is not re-enabled until the alarm condition is cleared, and an operator pushes a software RESET pushbutton at the OIT/SCADA.
 - (2) The PLC DO start command shall be disabled when there is a loss of control power to the Pump Control Panel PLC. When control power becomes available, three software on-delay timers are started (initially set for 30, 60 and 90 seconds, respectively). When the first timer expires, the PLC start output for the Lead pump is re-enabled. When the second timer expires, the PLC start output for the Lag pump is re-enabled.
 - d. Process Alarm Logic: A valve fail to open alarm shall be annunciated if a pump has been called to run and after an adjustable software-based on-delay timer expires, the valve position switch (ZS-##) is not reporting that the valve has opened.
5. PCP Hard-wired Backup Control: Contacts from the wet well float switches (LSHH-221, LSHH-222, LSSL-221 and LSSL-222) are used in a hard-wired backup level control circuit for each pump. Details of the control circuit are shown in the Instrumentation Drawings. If Backup Level Control is enabled and the pump H/O/A selector switch is not in the AUTO position, then the OIT/SCADA shall display the message: PUMP NO. * NOT AVAILABLE FOR BACKUP LEVEL CONTROL.
6. Alarms at OIT/SCADA

- a. VFD Fault
- b. Motor High Temperature
- c. High Moisture Alarm
- d. Run Failure
- e. E-Stop
- f. Valve Fail to Open/Flow Alarm
- g. Fail to Start
- h. Torque Alarm
- i. High Amperage Warning and Setpoints
- j. High Amperage Shutdown and Setpoints
- 7. Monitoring/Status/Control at OIT/SCADA
 - a. H/O/A Selector Switch in AUTO
 - b. Run Status
 - c. Elapsed Runtime Meter (0.0 - 999,999.9 hours)
 - d. Speed indication (0.0 to 100.0%)
 - e. Speed command (0.0 to 100.0%)
 - f. Ampere Draw indication (0.0 to 50.0) (TBD)
 - g. Service Selection Table and Auto Alt. Pushbutton
 - h. Proportional Band Algorithm parameters
 - i. Reset Pushbutton
- F. Loop 290 - ATS/Generator Monitoring
 - 1. General: Status and alarms of the ATS and station generator are monitored. Power monitoring information shall be available to the PLC/OIT/SCADA via an Ethernet connection between the Ethernet switch in the Pump Control Panel and Division 16 furnished power monitoring equipment.
 - 2. Local Monitoring/Control
 - a. None at Pump Control Pump.
 - 3. PLC Functions
 - a. Inputs
 - (1) DI: Generator Run Status
 - (2) DI: Generator Failure
 - (3) DI: ATS in Normal position
 - (4) DI: ATS in Emergency position
 - (5) AI: Fuel Level
 - b. Via an Ethernet network link, the PLC shall poll, the Division 16 furnished power monitoring equipment to collect data regarding the state of the pump station power feed. The information to be polled and displayed shall be determined during construction.
 - 4. Alarms at OIT/SCADA
 - a. Generator Failure
 - b. ATS in Emergency indication
 - 5. Monitoring/Status/Control at OIT/SCADA
 - a. Generator Run Status indication
 - b. Generator Elapsed Runtime Meter (0.0 - 999,999.9 hours)
 - c. ATS in Normal indication
 - d. Power Monitoring System data (TBD during construction)

- G. Loop 250 - Pump Station Monitoring
 - 1. General: Existing monitoring and alarm signals connected to the new PLC in the new Pump Control Panel.
 - 2. Local Monitoring/Control
 - a. None.
 - 3. PLC Functions
 - a. Inputs
 - i. DI: Flood Alarm
 - ii. DI: Power Fail
 - iii. DI: Wet Well 1 Hazardous Gas Alarm
 - iv. DI: Wet Well 2 Hazardous Gas Alarm
 - v. AI: Wet Well Temperature (4 to 20 mA DC scaled -10°F to 110°F)
 - vi. AI: Dry Well Temperature (4 to 20 mA DC scaled -10°F to 110°F)
 - vii. AI: City Water Pressure (0-120 psi)
 - 4. Alarms at OIT/SCADA
 - a. Flood Alarm
 - b. Power Fail
 - c. Wet Well 1 Gas Alarm
 - d. Wet Well 2 Gas Alarm
 - e. Wet Well Low Temperature Alarm
 - f. Dry Well Low Temperature Alarm
 - g. Dry Well High Temperature Alarm
 - h. City Water Pressure Alarm
 - 5. Monitoring/Status/Control at OIT/SCADA
 - a. Wet Well Temperature Indication
 - b. Dry Well Temperature Indication
 - c. City Water Pressure Indication and Trending
- H. Loop 260 - Telemetry System Interface
 - 1. General: Alarm conditions at the pump station are reported to the existing using radio telemetry system. The PLC communicates with the radio via Ethernet.
 - 2. Local Monitoring Status and Alarms
 - a. The following alarms/statuses shall be communicated and require local reset:
 - i. ATS GEN
 - ii. ATS NORM
 - iii. Pump Running (all pumps)
 - iv. Backup Control
 - v. GEN Running
 - vi. GEN Failure
 - vii. Low Level
 - viii. High Level
 - ix. Flood Alarm
 - x. Pump Station Common Alarm
 - 3. PLC Functions
 - a. Alarm Logic

- i. A Pump Failure Alarm is activated if any of the pumps is reporting a Run Failure condition.
 - ii. A Wet Well High-High Level Alarm is activated if either wet well high-high level switch is reporting high-high level (see Loops, 221 and 222)
 - iii. A Wet Well Low-Low Level Alarm is activated if either wet well low-low level switch is reporting low-low level (see Loops 221 and 222)
 - iv. A Pump Station Common Alarm is activated upon any of the following conditions:
 - (1) Comminutor Failure
 - (2) High Level Alarm in either wet well
 - (3) Low Level Alarm in either wet well
 - (4) Generator Failure Alarm
 - (5) Pump Valve Fail to Open
 - (6) ATS in Emergency position
 - (7) Wet Well 1 Hazardous Gas Alarm
 - (8) Wet Well 2 Hazardous Gas Alarm
 - (9) Wet Well Low Temperature Alarm
 - (10) Dry Well Low Temperature Alarm
 - (11) Dry Well High Temperature Alarm
4. Alarms at OIT/SCADA
- a. None.
5. Monitoring/Status/Control at OIT/SCADA
- a. None.

END OF SECTION

SECTION 13442

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish, install, program and test the programmable logic controllers (PLCs) as shown in the Instrumentation Drawings and described in Specification Sections 13440 and 13442 herein. Operator interface terminals (OITs) will be provided to monitor and control operating parameters within the PLCs.
- B. Work Included: Furnish, install, configure, wire, and test the uninterruptable power supply (UPS) and maintenance bypass switch (MBS) as shown in the Instrumentation Drawings and described in Specification Sections 13440 and 13442 herein.
- C. Related Work Specified Elsewhere:

<u>Section</u>	<u>Title</u>
13410	Instrumentation and Process Control General
13440	Instrumentation and Process Control
13441	Control Loop Descriptions
13444	Control Panels
13445	Communications Network
Division 16	Electrical Requirements
	Electrical and Instrumentation Drawings

1.2 QUALITY ASSURANCE

- A. The PLCs and OITs form an integral part of the overall control system for the facility and as such all PLCs and OITs shall be the product of one manufacturer. The Contractor shall provide all coordination as necessary to ensure that all PLCs and OITs, whether provided by the System Integrator, individual equipment manufacturers or others, are by the same manufacturer.
- B. The manufacturer or its authorized representative shall provide complete technical support for all of their products.

1.3 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions of the Construction Contract, Section 01340 (Submittals) and Section 13440.
- B. Ladder logic will be fully documented including a listing of each task/function.
- C. Submit the following:
 - 1. PLC I/O configurations
 - 2. PLC communication configurations
 - 3. PLC cross reference list
 - 4. PLC tag data base and memory usage
 - 5. OIT communication configurations
 - 6. OIT Screen List
 - 7. OIT Screen printouts

1.4 DELIVERY, STORAGE AND HANDLING

- A. In accordance with Section 13440.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The PLC shall consist of rugged components designed specifically for industrial environments. The PLC shall consist of a power supply and one or more racks containing a central processing unit (CPU) module, I/O modules, PLC memory, and PLC network interface module(s). All components shall be housed in structurally secure enclosures.
- B. The central processing unit CPU shall be modular and fully enclosed within a durable plastic shroud. When mounted on the system base, the modular CPU shall not occupy more than one available slot.
- C. The I/O system shall be modular. Each module shall be fully enclosed within a durable plastic shroud. When mounted on the system base, each I/O module shall not occupy more than one available slot.
- D. All components within the controller family shall be manufactured with a high degree of durability. All switches and other operator-controlled devices shall be of the size and durability for their intended use as is normally offered for industrial applications. All signal and/or rack expansion cables furnished by the manufacturer shall be constructed so as to withstand, without damage, all normal use and handling.
- E. In order to minimize spare parts stocking requirements, the controller family shall have a high degree of interchange ability. The system shall incorporate a modular design using plug in assemblies with pin and socket connectors. Wherever possible, all assemblies and sub-assemblies performing similar functions shall be interchangeable. The system design shall accommodate the replacement of assemblies/modules without having to disconnect field wiring. Wherever possible, removable connectors shall be used to connect field wiring to the individual circuit board assemblies. All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings each of which indicates the manufacturer's catalog number and a product manufacturing date code.
- F. Refer to the control panel descriptions in Specification Section 13444, article 2.2.

2.3 PROGRAMMABLE LOGIC CONTROLLERS (PLCS)

- A. The Programmable Logic Controller (PLC) as identified on the Instrumentation Drawings, shall be capable of performing the functions and handling the network communications as described in Section 13440 and 13441.
- B. The following Control Panels provided by Division 13 shall have a PLC:
 - 1. PCP-Old Norwich Road
- C. PLC Min. Memory: 2 MB of programmable memory with battery backed-up static RAM.
- D. Max. Bit Execution Time: 0.4 microseconds
- E. Power: 110/220 VAC power supply. Each PLC and Remote I/O Module shall be powered by an uninterruptible power supply (UPS)
- F. Required agency approvals:
 - 1. UL Listed (UL 508)

2. CSA Certified (CSA 142)
- G. PLC External Communications: The PLC shall contain minimum of 1 USB Port and 2 Ethernet ports.
- H. Programming and diagnostic software shall be Windows based via Relay Ladder Logic (RLL) custom programming tools for the PLCs. Provide all necessary programming time required to configure each PLC to provide complete control and monitoring functions as described in Sections 13440 and 13441 and as finalized in the instrumentation meetings described below. All licensed PLC development and programming software shall be provided on CD ROM.
- I. Provide a licensed copy licensed to and in the Owner's name, of all required PLC programming software, communication drivers, hardware interface, and cables used to program the PLC.
- J. Provide memory module and battery backup.
- K. PLC and Remote I/O Requirements:
 1. Discrete Inputs: 120 VAC and 24 VDC as required, maximum of 16 points per module.
 2. Discrete Outputs: 120 VAC Relay outputs. Maximum of 16 points per module.
 3. Analog Inputs: 4-20 mA DC, minimum 12-bit resolution. Maximum 8 channels per module. Provide differential Inputs.
 4. Analog Outputs: 4-20 mA DC, minimum 12-bit resolution. Maximum 8 channels per module. Provide differential Outputs.
 5. Combination Analog Input/Output Modules shall not be permitted.
- L. Future Connections: Provide a minimum of the following for future connections:
 1. 20% additional discrete inputs per PLC (rounded up) wired to terminal blocks
 2. 20% additional discrete outputs per PLC (rounded up) wired to interposing relays and terminal blocks
 3. 10% with a minimum of four (4) additional analog inputs per PLC wired to terminal blocks
 4. 10% with a minimum of two (2) additional analog outputs per PLC wired to terminal blocks
 5. two (2) module spaces for future input, output, or special modules
- M. Spare Parts: Provide a minimum of the following spare parts for Division 13 panels only:
 1. one (1) PLC Processor
 2. one (1) PLC Power Supply
 3. one (1) Analog Input Module
 4. one (1) Analog Output Module
 5. one (1) Digital Input Module
 6. one (1) Digital Output Module
 7. one (1) Specialty Communication Module (as applicable).
- N. Acceptable Programmable Logic Controller (PLC):
 1. Allen Bradley CompactLogix 5069 Series
 2. Or equal

2.4 OPERATOR INTERFACE TERMINALS

- A. General: Provide an Operator Interface Terminal (OIT) at each control panel to continuously indicate status of equipment, change operational parameters and

indicate alarm status as described in Sections 13440 and 13441. The OIT shall be fully compatible with the PLC provided. The following Control Panels provided by Division 13 shall have an OIT:

1. PCP-Old Norwich Road
2. OIT-Panel-Old Norwich Road
- B. Screen Size: 15.6-inch IPS LCD screen with a minimum resolution of 1920x1080 pixels with field replaceable backlight.
- C. Interface: Touchscreen rated at 1 million cycles (minimum).
- D. Memory: 4 GB minimum application and graphic memory. 1 GB System RAM
- E. Clock: Provide integral real time clock with battery backup.
- F. Communication: RS-232, Ethernet and USB ports.
- G. Power: 24 VDC
- H. Operating Temperature: 32-130°F
- I. Enclosure: NEMA 12 with NEMA 4X front-face and touchpad
- J. Provide a licensed copy licensed to the name of the Owner, of all programming software, drivers, hardware interface and cable used to configure the OIT.
- K. Provide programming time required to configure OIT interface as described in Sections 13440, 13441 and finalized in the instrumentation meetings.
- L. Provide all cables required to connect the OIT to the network or PLC.
- M. The integrated OIT software shall have the following features:
 1. Trending
 2. Data Logging
 3. Alarms
 4. Graphic Symbols
 5. Animation
- N. Acceptable Operator Interface Terminal (OIT):
 1. Maple Systems cMT3162X
 2. No or Equal.

2.5 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

- A. Provide a uninterruptible 120-volt backup power supply for each PLC, OIT, Ethernet switch or other device as shown on the Drawings to maintain continuous operation of PLCs, operator interface terminals, Ethernet switches, monitoring instrumentation and control and process circuits during a power outage.
- B. The following Control Panels shall be provided with 120-volt UPS:
 1. PCP-Old Norwich Road
 2. OIT-Panel- Old Norwich Road
- C. UPS type shall be provided as a continuous-duty, on-line, solid state, double conversion, single-phase 120 VAC input, single-phase 120VAC true sinewave output uninterruptible power system with auto-bypass. The UPS shall be provided with surge arresting capabilities to prevent sudden surges to the attached electrical control systems.
- D. The UPS will be inside the control panel, located in the bottom section of floor stand type control panels or provided an independent wall mounted enclosure. The UPS shall be installed per UL 508 requirements.
- E. Provide appropriate maintenance bypass switch as specified herein to easily remove and bypass the UPS.

- F. The UPS shall have “hot-swappable” batteries and be capable of being replaced with the UPS in operation. The run time operation of the UPS shall be accomplished using batteries mounted within the UPS enclosure and supplemented as necessary with batteries in an enclosure to provide the battery runtime specified herein. The battery enclosure shall match the main UPS enclosure as closely as possible.
- G. The UPS shall come equipped or provided with an added interface card with the means to signal the following alarms using dry contacts input to the control panel PLC:
 - 1. UPS Fault
 - 2. UPS on Battery Power
 - 3. UPS on Static Bypass
 - 4. Battery Low
- H. The UPS shall be type rated for industrial use and capable of supplying standby power to all connected control panel equipment and circuits at peak load for a minimum of fifteen (15) minutes at full load, thirty (30) minutes half load. UPS minimum rating shall be 750 VA.
- I. Acceptable manufacturers:
 - 1. Schneider Electric APC Smart-UPS
 - 2. Liebert GXT3 Series
 - 3. Tripp-Lite SU Series
 - 4. Eaton Powerware
 - 5. or equal.

2.6 MAINTENANCE BYPASS (MBP)

- A. Each UPS shall be provided with a two-position external maintenance bypass switch and outlet system to permits the UPS to be removed for repair or maintenance without causing power disruption to the connected power loads. The external bypass switch shall be a snap-action type with switching speed 10ms or less independent of operator action. External bypass switch positions shall be labeled UPS and UTILITY. The bypass switch shall be capable of switching the required amps for the UPS system.
- B. For UPS units up to and including 3 KVA, furnish Liebert MicroPOD, Tripp-Lite PDUB15, or equal
 - 1. Substitution of standalone switches, such as Electroschwitch series 103 snap action switch (or equal), along with custom plugs, receptacles, and appropriate wiring to achieve the specified functionality is acceptable.
 - 2. For UPS units above 3 KVA, substitute standard manufacturers Maintenance Bypass switch offering or standalone switches as indicated above.

PART 3 - EXECUTION - In accordance with Sections 13440 and 13444

END OF SECTION

SECTION 13444

CONTROL PANELS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Includes: Furnish, install, test, and commission the following panels listed in the control panel schedule. Provide enclosure NEMA ratings shall be as indicated in the control panel schedule and the Electrical Drawing - Electrical NEMA Classifications and Conduit Installation Schedule.

B. Related Work Specified Elsewhere:

Section	Title
13410	Instrumentation and Control General
13440	Instrumentation and Process Control
13441	Control Loop Descriptions
13442	Programmable Logic Controllers
13445	Communications Network

Division 16 Electrical Requirements
Electrical and Instrumentation Drawings

1.2 CONTROL SYSTEM TESTING:

A. Tests Procedures Prior to Start-up:

1. Factory Acceptance Test (FAT): An unwitnessed Factory Acceptance Test and verification for all deliverable equipment, software, and associated documentation shall be performed prior to shipment of control systems. The factory tests shall be performed to verify that the control systems are manufactured and assembled correctly, are operating as designed, and in compliance with the contractual requirements for the deliverables. Communication and integration with Division 11 equipment shall be demonstrated by indication of network addresses and required data tags with forced status/value changes to be witnessed on SCADA. The FAT documentation when conducted shall be submitted to the ENGINEER and/or the OWNER'S for approval.
2. The FAT shall include verification and integrated testing of all components. These tests shall include the following.
 - a. Visual Inspections: The following inspection checks shall be performed on all deliverable hardware items, as a minimum:
 - i. I/O Subsystem physical layout
 - ii. Power supply mounting
 - iii. Power cable routing
 - iv. Data cable routing and mounting
 - v. Wiring runs properly separated and installed
 - vi. Fans, blowers, and heaters are unobstructed
 - vii. Power supply and power conditioning equipment correctly installed

- viii. Wire numbering and color coding
- ix. Device labeling
- x. Enclosure integrity
- xi. Paint work
- xii. Control panel lighting
- xiii. Panel and enclosure ground connections
- xiv. Provide photos:
 - (1) Panel Exterior
 - (2) Panel Interior – Door
 - (3) Panel Interior – Enclosure
 - (4) Incoming power distribution
 - (5) PLC
 - (6) Communications devices
 - (7) Rear view of enclosure OIT
- b. I/O Point Checkout:
 - i. The System Integrator shall perform a complete checkout for every I/O point from the field wiring terminal strip to the operator interface terminal functions. The System Integrator shall test every input and output point including spares for proper operation. Test signals shall be generated to verify the operation of each Analog Input (AI) and Discrete Input (DI) including connected interposing relays, intrinsically safe circuits and relay circuits. Each Analog Output (AO) and Discrete Output (DO) shall be also tested for proper operation including control circuits, isolation relays, signal conditioner/isolators and other required control circuits.
 - ii. The System Integrator shall demonstrate that signals are alarmed when reporting under 4 mA and over 20 mA and do not report negative or out of range values.
 - iii. The System Integrator shall develop a point checkout form for each I/O point. The point checkout form shall include the point ID, description, all checks performed for the point, date and time of the check, and a signoff block for the System Integrator. For each item checked, the form shall include both the expected value/result and the actual value/result witnessed.
 - iv. The following items shall be checked for each I/O point:
 - (1) For each analog input point, the following values shall be checked:
 - (a) Value at -2% of full scale (ramped in both directions)
 - (b) Value at 0% of full scale (ramped in both directions)
 - (c) Value at 25% of full scale (ramped in both directions)
 - (d) Value at 50% of full scale (ramped in both directions)
 - (e) Value at 75% of full scale (ramped in both directions)

- (f) Value at 100% of full scale (ramped in both directions)
 - (g) Value at 102% of full scale (ramped in both directions)
 - (h) Each High and Low Alarm condition
 - (i) Alarm Delay
 - (j) Alarm Enable/Disable
 - (2) For each analog output point, the following values shall be checked:
 - (a) Milliamp reading at 0% of full scale (ramped in both directions)
 - (b) Milliamp reading at 25% of full scale (ramped in both directions)
 - (c) Milliamp reading at 50% of full scale (ramped in both directions)
 - (d) Milliamp reading at 75% of full scale (ramped in both directions)
 - (e) Milliamp reading at 100% of full scale (ramped in both directions)
 - (3) For each discrete input point, the following items shall be checked:
 - (a) For status points, proper indication
 - (b) For alarm points, proper alarm notification
 - (4) For each discrete output point, the following items shall be checked:
 - (a) Proper operation
- c. PLC Programming and OIT Operation Checkout:
 - i. Submit the proposed PLC program and OIT Configuration (screen printouts) as a shop drawing 15 days prior to the performance of the Factory Acceptance Testing .
 - ii. Verify to the extent possible that the PLC program and OIT Operation, as submitted, performs all control and monitoring requirements as described in section 13441 - Control Loop Descriptions. A list of all modifications to the submitted PLC program shall be maintained and submitted after the FAT.
- d. 48-Hour Continuous Burn-in Test:
 - i. After the successful completion of the functional testing specified above, a 48-hour continuous run of each control panel provided shall be performed. The test shall be passed if no function is lost, no hardware or software failure occurs, and no module automatic failover occurs. Hardware failure is defined for this test as the loss of a major piece of hardware, such as a PLC processor, I/O board, power supply, UPS, other panel equipment, or improper operation by the controller.
 - ii. During this test, the PLC shall be occasionally (a minimum of 3 times per 24-hour period) exercised with simulated inputs, events,

and conditions in a manner that approximates an operational environment in order to verify proper operation.

- iii. No programming changes will be allowed to bypass failed modules during this test. Any major software and/or hardware correction made to the control panel shall result in the mandatory rerun of the entire 48-hour test for that control panel.

B. Procedures Prior to Start-up:

1. The Contractor shall coordinate the work of the system manufacturer's service personnel as necessary. This shall include the installation, interconnection, testing, and calibration of the instruments, and the scheduling of the manufacturer's service personnel.
2. The supervisory services of a factory-trained service engineer/technician who is specifically trained on the type of equipment herein specified, shall be provided during construction to assist the Contractor in the methods of installing conduit and special cable; mounting, piping, and wiring of one of each type of device, and the methods of protecting all of the equipment prior to placing it into service. Upon completion of the installation, a trained service engineer/technician will calibrate and startup the equipment in the presence of the Engineer and provide instruction and training for the operating personnel. A sufficient number of service days shall be provided to place the system in satisfactory operation.
3. The Owner will assume no liability or responsibility for any portions of the installation under this Contract until they are demonstrated and accepted in writing. Final demonstrations shall be made only after the Owner and Engineer are satisfied that the work has been completed in accordance with the intent of the Contract Documents.

C. Onsite Control System Startup:

1. Site Acceptance Test (SAT): Perform a witnessed Site Acceptance Test to verify that each instrument and equipment drive is connected properly to the control panel and that all functions of the control panel are operating as specified.
 - a. The System Integrator shall:
 - i. Verify the facility installation.
 - ii. Demonstrate each functional requirement identified by the Specification. This demonstration shall repeat the tests used during the FAT but using real rather than simulated conditions.
 - iii. Demonstrate all equipment control functions, including the operation of automatic control strategies. Actuation of field devices and operation of equipment shall be closely coordinated with Engineer and Owner's staff.
 - iv. Demonstrate that the parameters for each PID operation in the PLC provide a smooth responsive transition without over oscillation with a sudden change in the process value or set point. PID parameters will be determined, verified, and demonstrated with PID tuning software that displays trending of the process variable, controlled variable, and set point over time.

- v. Verify system performance parameters and system responses under field operational conditions.
- vi. Verify accuracy of documentation, especially operator's manuals, software documentation, and site operating instructions.
- vii. Provide final instrument field calibration sheet/documentation.
- viii. Provide completed SAT testing documentation: I/O signal, PLC code and SCADA Screen Printouts with verification of Section 13441 – Control Loop Descriptions. Any approved modifications of the Control Loops by the Engineer and successfully tested during the SAT, shall be documented by the System Integrator.
- b. The SAT will be observed by the Engineer and/or Owner's representative.
- c. Provide the services of authorized manufacturers' representatives to instruct the Owner's representatives in the proper operation of each control system installed under this Contract.

1.3 QUALITY ASSURANCE

- A. The specifications direct attention to certain required features of the equipment but do not purport to cover all details entering into its design and construction. Nevertheless, the Contractor shall furnish the control panels complete in all details and ready for operation.
- B. The control panels are an essential component of an integrated system with all plant controls and as such shall be supplied by the System Integrator in accordance with Sections 13440 and 13441.

1.4 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions of the Construction Contract, Section 01340, Submittals, and Section 13440.
 - 1. Control Panel Layouts, Wiring Diagrams, Network/Communication Diagrams
 - 2. Bills of Materials (with separate columns for the following: Item Number, Quantity, Manufacturer, Part number, Description, Designator Tag)
 - 3. FAT Report Results
 - 4. SAT Report Results

1.5 DELIVERY, STORAGE AND HANDLING

- A. In accordance with Section 13440.

PART 2 - - PRODUCTS

2.1 MATERIALS

- A. General: Refer to the General Conditions of Section 13440.
- B. Intrinsically Safe Equipment
 - 1. Intrinsically Safe Relay/Barrier Panels (ISP):
 - a. All instrumentation that is located in classified spaces must be either explosion proof or intrinsically safe. All instrumentation that is intrinsically safe shall be provided with intrinsically safe relays and barriers. Refer to the Instrumentation Drawings for all signals that shall be protected with intrinsically safe relays and barriers.

- b. Intrinsically safe relays and barriers shall be housed in a dedicated Intrinsically Safe Relay/Barrier enclosure.
 - c. Intrinsically Safe Relays and Barriers may be located in the same enclosure but will not be permitted to be included in the PLC control panels.
 - d. Each enclosure shall be sized appropriately to accommodate a minimum of 20% future I/O capacity.
 - e. Provide all necessary power supplies, terminals, and circuit breakers in the panel for proper operation.
 - f. Intrinsically Safe Relay/Barrier panels shall be UL 508A and 698 listed and labeled.
2. Intrinsically Safe Relay/Barrier Enclosure Requirements:
- a. The enclosure shall be a wall mount, single door continuous hinged NEMA 4X 304 stainless steel enclosure.
 - b. A yellow lamicoid label with the words "Intrinsically Safe Enclosure" shall be affixed to the front door of the enclosure.
 - c. The enclosure shall close with stainless steel screw clamps and have a hasp and staple for padlocking.
 - d. Refer to this section for general NEMA 4X enclosure requirements.
3. Intrinsically Safe Relays:
- a. Relays shall be provided for all intrinsically safe sensing or actuation circuits which terminate in hazardous areas.
 - b. Relays shall be located in non-hazardous areas and installed in accordance with UL requirements.
 - c. Refer to the instrumentation drawings for signals that require Intrinsically Safe Relays. Relays shall be 120VAC powered.
 - d. Approvals: FM
 - e. Equal to:
 - i. Phoenix Contact
 - ii. Gems Safe Pak
 - iii. MTL 7700 Series
 - iv. or equal
4. Intrinsic Safety Barriers
- a. Barriers shall be provided for all intrinsically safe sensing or actuation circuits which terminate in hazardous areas.
 - b. Barriers shall reduce the level of energy as required by intrinsically safe protection between safe and hazardous locations.
 - c. Barriers shall be suitable for use with 4 to 20 mA DC signals.
 - d. Barriers shall be located in non-hazardous areas and installed in accordance with UL requirements.
 - e. Refer to the instrumentation drawings for signals that require Intrinsically Safe Barriers. Relays shall be 120VAC powered.
 - f. Approvals: FM
 - g. Equal to:
 - i. Phoenix Contact
 - ii. Gems Safe Pak

- iii. MTL 7700 Series
- iv. or equal
- C. Level Indication Display Panels:
 - 1. Level Indication Display Panels (LIDP):
 - a. Level indication display panels shall be provided for Wetwell where the indicating transmitter cannot be seen from floor level or a blind transmitter is specified.
 - b. Level Indication Display Panels shall be mounted adjacent to each chemical storage tank as shown on the Electrical Drawings.
 - c. The level indicator display panel shall include a level indicator and signal splitters as shown on the Instrumentation Drawings mounted in a NEMA 4X enclosure. The level indicator display shall be LED type and front panel mounted to the enclosure.
 - d. The level indicators shall be configured to display the level of chemical in the tank in feet from the tank floor.
 - 2. Level Indication Display Panel Enclosure Requirements:
 - a. The enclosure shall be a wall mount, single door continuous hinged NEMA 4X polycarbonate enclosure.
 - b. The enclosure shall close with captive screws.
 - c. Enclosure shall be provided with a back panel for mounting interior devices.
 - d. Enclosure door shall be sealed with a seamless foam in place gasket which maintains a NEMA 4X rating.
 - e. A lamicoid label on the door of the enclosure shall identify the Level Indication Display Panel. (e.g. LIDP-221 – Wet well No. 1).
 - f. Cover and enclosure main body shall be opaque.
 - g. Enclosure shall be equal to Saginaw Control and Engineering or Hoffman.
- D. Process Equipment Local Control Panels:
 - 1. Local Control Panels (LCP):
 - a. Local control panels, furnished by Division 13, will be used to protect the equipment from operating with hardwired interlocks. These panels will be located adjacent to the equipment as shown on the Electrical Drawings.
 - b. The local control panels will consist of latching relay logic that will protect the equipment based on instrumentation that is provided by the equipment vendor. (e.g. a High Discharge Pressure switch)
 - c. Each panel will include alarm light indicators and a reset push button to unlatch the alarm. For wiring diagrams of each panel, see the schematic on drawing.
 - d. All required circuit breakers and relays shall be DIN rail mounted to a subpanel in the enclosure.
 - e. A lamicoid label on the door of the enclosure shall identify the panel. Label shall include the panel tag number and the panel name as indicated in the list below.
 - 2. Local Control Panel Enclosure Requirements

- a. Each local control panel enclosure shall be a wall mount, single door continuous hinged enclosure that meets the NEMA rating of the area that it is installed in. See the Electrical Drawings for area NEMA ratings.
 - i. NEMA 4X shall be 304 stainless steel.
 - ii. NEMA 7 shall be cast aluminum explosion proof
 - iii. NEMA 12 shall be painted steel.
 - b. The enclosure shall open with a padlock-able three-point latch. Additional miniature quarter turn latches may be used around the door if they are required to maintain the NEMA rating. These quarter turn latches shall be able to be turned by hand, not with the use of a screw driver. Edge screw clips will not be accepted.
 - c. Refer to this section for general enclosure requirements.
- E. Control Panels
- 1. PLC Control Panels (CP):
 - a. PLC control panels, furnished by Division 13, shall house all of the required PLC and communications equipment. Provide the following:
 - i. PCP by Division 13
 - ii. OIT-PANEL by Division 13
 - b. For PLC and OIT hardware in the panel, see Programmable Logic Controllers - Section 13442.
 - c. For other components in the panels, see Control Panel Components section herein.
 - d. A lamicoid label on the door of the enclosure shall identify the PLC Control Panel. Label shall include the panel tag number and the panel name as indicated on the Instrumentation Drawings and in the list below.
 - e. The enclosure ratings shall be NEMA 12 or NEMA 4X, refer to Electrical drawing E-1 for NEMA ratings required by area.
 - f. Refer to Electrical power plans for maximum panel sizes (use scaled drawings).
 - 2. PLC Control Panel Requirements
 - a. Each control panel enclosure shall be a NEMA 12 or NEMA 4X enclosure. The panel shall be sized by the System Integrator house all equipment and room for 20% I/O expansion and meet UL 508A requirements. Control panel enclosures shall be continuously hinged.
 - b. All control components shall be mounted using a 35 mm DIN rail.
 - c. The center of the Operator Interface Terminal (OIT) or Human Machine Interface (HMI) shall be mounted no higher than 63" and no lower than 57" above the finished elevation where an operator will stand.
 - d. Provide a PLC control panel shall be provided with a marshaling shelf for top conduit entry cable management as indicated in the panel schedule.
 - e. Floor mount Panels will be located on a 4" high housekeeping pad. Provide a window-kit for outdoor installation.
 - f. Outdoor installations:
 - i. Provide a dead-front enclosure with front panel components mounted to the interior swing-door kit.
 - ii. Provide enclosure with provisions for mounting in a NEMA 4X

- enclosure.
- iii. If a dead-front enclosure is not provided, a window kit and sunshield shall be provided for OIT installation.
 - iv. Conduit penetrations on top of enclosure shall not be permitted.
- g. Unheated spaces or general outdoors:
- i. Shall be equipped with a factory installed built-in heater and adjustable thermostat to heat enclosure to the minimum operating temperature of the installed devices.
 - ii. The heater shall include a fan to circulate the air within the enclosure to prevent hot spots. Thermostat shall measure air temperature, not surface temperature.
 - iii. Heater shall be Hoffman Enclosures DAH series or approved equal.
 - iv. For smaller panels where an enclosure heater would exceed the requirements (temperature, spacing), provide a strip heater with thermostat for condensation control. Strip heaters shall be provided with thermally insulated mounting.
 - v. Panel heaters shall be installed in the bottom 1/3 of the control enclosure to assist in thermal efficiency.
 - vi. All panels installed in regions with an annual mean minimum dry bulb temperature less than 0°F shall have 1" Rigid Fiberglass Insulation installed. The insulation shall:
 - (1) Be of a type that conforms with ASTM C612 Type 1VB, C795
 - (2) Be installed using mechanical fastening or an adhesive that is listed with a MAGW2 rating.
- h. Special Cooling Requirements
- i. Thermal gain calculations shall be provided for all panels provided for or modified in this contract. These calculations shall include all thermal gain sources internal to the panel as well as external factors such as elevated ambient air temperatures, solar gain and any other factors identified by the engineer during the submittal process.
 - (1) Solar Gain shall be calculated by the following table of values using the area of the enclosures Front Face, Top and one side. Sides protected by a sun shield with air gap may be omitted:

Panel Color/Finish	Watts/SqFt
Black	9
Stainless/Grey	7
White	1

- ii. Enclosures installed in high ambient heat areas or which contain Variable Frequency Drives (VFDs) or other heat-producing equipment shall be provided with modifications and/or accessories designed to dissipate excess heat and allow for proper equipment cooling, while maintaining the enclosures NEMA rating. Following

are several accessories which may be used, depending upon the ambient temperature and NEMA rating of the area installed.

- (1) Heat exchangers with circulating fans and filters, for NEMA 12 enclosures.
 - (2) Air conditioners, for NEMA 12 or NEMA 4X enclosures in areas with high ambient temperatures. NEMA 4X air conditions shall be close-looped.
 - (3) Cooling fans shall be wired such that they only operate when the VFD or heat producing equipment is running.
 - (4) Air conditioners where used in enclosures shall operate constantly.
 - (5) Provide heat dissipation calculations and cooling method proposal for review and acceptance to be included as part of the shop drawing review for this equipment. Design ambient air temperature shall be 95°F.
- i. The enclosure shall open with a padlock-able three-point latch.
 - j. All equipment shall be DIN rail mounted to a subpanel in the enclosure.
 - k. Provide an LED enclosure light fixture for each panel door at the top of the enclosure with an accessible On/Off switch. Provide a duplex GFI receptacle in the panel with a label showing "For Test Instruments only/Computer use only". The receptacle and panel light shall be provided with a separate overcurrent protective device and connected in such a manner so as to not disconnect control, instrumentation, or PLC power in the event that the GFI outlet should trip.
 - l. Each PLC control panel shall have a UPS. See section 13442 for specific UPS requirements. The UPS shall be mounted inside of the enclosure on a specific UPS shelf which keeps it off of the floor of the enclosure. Provide a UPS maintenance bypass switch (MBS) that allows the panel to be powered through the UPS or from line power.
 - i. Unless stated otherwise each field instrument whether powered by 120 VAC or 24 VDC shall be powered from the associated Control Panel's UPS. Field instruments that measure processes that are not disrupted during a power outage, require a significant amount of time to reset after power is restored from a power outage, or will cause disruptions to process control if the process value is not immediately available once power is restored shall be backed up by the UPS from the associated Control Panel.
 - ii. The following shall NOT be powered from the UPS:
 - (1) Control panel lighting.
 - (2) Control panel heating.
 - (3) Control panel cooling.
 - (4) Instrumentation powered from control panel, but not indicated by UPS power as indicated on the Instrumentation and Electrical Drawings.

F. Components and Requirements:

1. Enclosures

- a. Shall at project completion be UL508A and if required UL698 Listed as an assembly, as indicated in schedule.
- b. Enclosures shall be sized as required to contain the necessary apparatus for the particular installation. Final panel/enclosure dimensions shall provide for easy access to all internal components with ease of maintenance and future modifications considered. Enclosure size shall accommodate UL requirements. Conflicts with panel sizing and available spacing shall immediately be brought to the attention of the Engineer prior to proceeding to procurement. Panels purchased without submittal/Engineer approval that present installation/egress/clearance issues shall be replaced by the Contractor at no additional cost to the Owner/Engineer.
- c. Panels larger than 36-inches in any dimension shall not be wall mounted. Provide two doors if panel is larger than 36-inches wide.
- d. Enclosures larger than 16" in any dimension shall utilize a three-point latching system.
- e. Provide door and body stiffeners where necessary for a rigid enclosure. Floor mounted enclosures shall be provided with lifting eyes and, where floor-mounted, with 12-inch floor stands. No floor stands are to be provided for free-standing models.
- f. Doors shall have side mounted, stainless steel, continuous length, piano-type hinges and pins.
- g. Panels/enclosures shall be equipped with print pockets located on the inside of the door.
- h. A complete "As-Built" panel wiring diagram including exterior devices and motors to be connected shall be encased in clear re-sealable plastic pouch(es) and placed in the print pocket.
- i. NEMA 12 enclosures shall be sheet steel, 16 gauge for box sizes up to and including 24" by 24", 14 gauge for box sizes larger than 24" by 24" up to 60" by 36", and 12 gauge for box sizes greater than 60" by 36". Free-standing enclosures shall be 12-gauge minimum. Enclosures shall have continuously welded seams, ground smooth, supplied with no holes or knockouts and a rolled lip around door and enclosure opening. Enclosures to be installed in areas with the potential for dripping liquids shall be provided with drip shields. Provide Oil resistant door gaskets. NEMA 12 enclosures shall be coated inside and out with ANSI 61 gray over phosphatized surfaces. Interior sub-panels for mounting of components shall be painted white.
- j. NEMA 4X stainless steel enclosures shall be Type 304 stainless steel enclosures shall be 16 gauge for box sizes up to and including 24" by 24", 14 gauge for box sizes larger than 24" by 24" up to 36" width, and 12 gauge for box widths greater than 36 inches. Free-standing enclosures shall be 12-gauge minimum. Enclosures shall have continuously welded seams, ground smooth, supplied with no holes or knockouts and a rolled lip around door and enclosure opening. Enclosures to be installed outdoors shall be provided with drip shields. Provide oil-resistant door

- gaskets all around door openings. All enclosure hinges, clamps, etc. shall be stainless steel. Enclosures/panels shall be provided unpainted, with metal enclosures having a smooth brushed finish.
- k. Interior sub-panels shall be made of the same type of material as the enclosure.
 - l. Provide enclosures equivalent to:
 - i. Saginaw Control and Engineering
 - ii. Hoffman
 - iii. Or equal
2. Control Panel Wiring Requirements:
- a. All control panel wiring shall conform to the latest requirements of NEC and all state and local code requirements.
 - b. Bundles of wires not in raceways must be secured to the panel structure every 8 inches minimum. All interior wiring will be point to point with no splices.
 - c. Wires to the front of panel devices shall be looped, extra flexible, bundled and located in a manner to prevent damage due to opening and closing the door.
 - d. All control wires internal to panels shall be minimum No. 14 AWG. Wires carrying line voltage shall be minimum No. 12 AWG. All conductors shall be copper. Wiring in close proximity to heating devices shall be Type AVA UL approved. All wiring shall be run in PVC wiring channels and bundled with nylon cable ties. Line voltage wiring must be run separately from control, signal and intrinsically safe wiring. PVC wiring channels shall be properly sized for the capacity of wires being installed based on the overall project needs and shall not be over filled.
 - e. Discrete and analog wiring shall be separated to the greatest extent possible. It shall be assumed that discrete and analog conduits shall be installed into the panel on opposing sides. PLC I/O modules slots and field terminal blocks shall be grouped by type.
 - f. All analog signal wire within the control panel shall be twisted/shielded pair (TSP) with a drain wire connected to a shield terminal. Analog wire and shields shall be continued from the terminal blocks to the PLC I/O modules. Should the Panel be provided without TSP, the engineer has the right to enforce this specification and the Panel Provider (System Integrator) shall furnish and install the correct TSP at no cost to the Engineer or Owner.
 - g. All branch circuits shall be provided overcurrent protection. PLCs, OITs, HMIs, instruments, power supplies (if not supplied with a field resettable fuse), and networking equipment shall have a dedicated fuse. Overcurrent protection shall be sized appropriately and account for inrush currents.
 - h. All outgoing power (120 V and 24 V) to field devices shall be fused.
 - i. Each digital input module shall have a dedicated fuse.
 - j. All wires shall be marked at both ends with numbers by self-sticking wire markers or with slip-on style plastic markers. Wire markers shall match the terminal block labels, unless otherwise specified.

- k. Wire color coding shall include the following:
 - i. Red wires - Interior control circuits
 - ii. Yellow wires - Power from external sources
 - iii. Blue wires - DC voltages
 - iv. Blue/White wires – DC return (i.e.-24VDC)
 - v. Green wires - Ground
 - l. Terminals shall all have unique numbering. Terminals that have identical labels under different terminal block numbers are not acceptable (ie. TB1-103 & TB2-103).
 - m. Terminals shall be arranged in alphabetic and numeric order in columns on removable sub-plates. A maximum of two connections shall be made to each side of a terminal, including jumpers. Provide an additional 20 percent spare terminals with the following minimum requirements:
 - i. Power terminals
 - (1) 1 spare 120VAC
 - (2) 1 spare 24VDC
 - ii. Control terminals
 - (1) 10 spare
 - iii. Signal terminals
 - (1) 4 spare
 - (2) 2 spare terminals wired for loop powered devices
 - n. Provide ground terminal for each panel.
 - o. All control panels shall be provided with spare mountings for additional relays. Number of spare mountings will correspond to 5% of the total number of relays within each panel, with a minimum of one (1) spare mounting.
 - p. All wiring entering and leaving control panels shall be terminated on field terminal blocks and labeled.
 - q. Provide individual surge protection for all for all field instruments mounted outside of the building or facility housing the control panel or as indicated on the drawings. Instruments mounted within the same structure as the associated control panel do not require surge protection.
 - r. Provide protection on all signal and data circuits that leave a building or are routed external to a building. Circuit protection shall be provided at both ends of the signal or data highway lines within the control panel at one end and as close to the instruments or termination device as possible.
 - s. Provide complete "As Built" wiring diagrams to be provided with the O&M manuals and in the enclosures for all control panels.
- 3. Programmable Logic Controllers (PLC):
 - a. Refer to Specification 13442 - Programmable Logic Controllers for PLC requirements.
 - 4. Operator Interface Terminal (OIT):
 - a. Refer to Specification 13442 - Programmable Logic Controllers for OIT requirements.
 - 5. Uninterruptible Power Supply (UPS):

- a. Refer to Specification 13442 - Programmable Logic Controllers for UPS requirements in Control Panels.
6. Ethernet Switches (Managed MES, Unmanaged ES):
 - a. Refer to Specification 13445 – Communications Network for MES and ES requirements.
7. Data/Power Port:
 - a. Provide a Data/Power port with Ethernet RJ45 jack and 120 VAC GFI outlet to meet Arc flash 70E requirements. Data power port will have a lockable hinged cover with panel mounted hardware and shall be installed on the front of the control panel.
 - b. Control panels with a keyboard shall have a Data/Power port with a USB connection.
 - c. Environmental Rating: To match panel NEMA rating.
 - d. The Data and Power port shall be:
 - i. Grace Engineered Products
 - ii. Hubble "Panel-Safe" Power and Data Access Ports
 - iii. Or equal
8. 12 and 24 VDC Power Supplies:
 - a. Provide 12 and 24 VDC power supplies in the control panel to power field instruments, panel devices, etc., as required.
 - b. No more than three internal panel devices or external field instruments requiring 12 or 24 VDC power shall be powered from a single 12 or 24 VDC power supply.
 - c. Input voltage: 115 VAC
 - d. Output voltage: 24 or 12 VDC.
 - e. Ripple: <50 mVpp.
 - f. The power supply shall have a NO fault /voltage OK contact.
 - g. Power supply shall be N+1 capable.
 - h. The power supply shall be sized to accommodate 125% of the design load.
 - i. Operating temperature: 32 to 140 °F.
 - j. The power supply shall be provided with a means to protect instruments from over current and over voltage.
 - k. Mounting: Din rail mount inside enclosures. Power supply shall be located in the enclosure such that heat generated does not cause other panel components to malfunction or become damaged.
 - l. 12 or 24 VDC power supplies shall be:
 - i. Sola SDN
 - ii. Allen-Bradley 1606
 - iii. or Equal
9. Hand Switches: HS
 - a. Push buttons and selector switches shall be 30 mm and heavy duty oil-tight.
 - b. Switches shall have the same NEMA rating as the panel that the switch is installed in.
 - c. Contact blocks shall be stackable and provide all necessary contacts as shown on the Drawings.

- d. Each switch shall be labeled as indicated on the Drawings.
 - e. Equal to:
 - i. Allen Bradley 800H series
 - ii. Eaton Cutler-Hammer HT800 series
 - iii. Or equal
10. Potentiometer:
- a. Potentiometers shall be 30 mm and heavy duty oil-tight.
 - b. Potentiometers shall have the same NEMA rating as the panel that the potentiometer is installed in.
 - c. Potentiometer ohm value shall be compatible with the equipment and application.
 - d. Equal to:
 - i. Allen-Bradley 800H Series
 - ii. Square D 9001 Series
11. Indicator Lights: YL, AL
- a. All indicator lights shall be 30 mm, heavy duty oil-tight, 120 VAC, LED with push to test option. Indicator Lights shall be wired such that they can be tested with Control or UPS Power source.
 - b. Lights shall have the same NEMA rating as the panel that the light is installed in.
 - c. Indicator lights shall be provided with a chrome-plated metal or anodized-aluminum mounting rings, engraved as indicated on the Drawings.
 - d. All indicating lights will use the following light color convention: See Instrumentation Drawing I-1 "Indicator Light Color Legend".
 - e. Equal to:
 - i. Allen Bradley 800H series
 - ii. Eaton Cutler-Hammer HT800 series
 - iii. Or equal
12. Fuses:
- a. Fuses shall be 3AB ceramic body fuses rated for at least 125 volts at the current ratings shown on the Drawings. Fuse size shall be ¼" by 1¼".
 - b. Blow time shall be: 110%, 4 hours minimum; 135%, 1-hour maximum; 200%, 15 seconds maximum for 1/8-12 amp fuses and 60 seconds maximum for 15-30 amp fuses.
 - c. Fuses shall be:
 - i. Entrelec
 - ii. Bussmann,
 - iii. Or approved equal.
13. Line Surge Protection:
- a. A UL1449 dedicated surge protection device (non-UPS) shall be installed for main power into a panel.
 - b. A UL1449 dedicated surge protection device (non-UPS) shall be installed for panel powered instruments located outside of the building.
 - c. Surge protection shall protect L-G, L-N and N-G.
 - d. Surge arrestor shall be adequate for intended function and shall be by a nationally recognized manufacturer with a minimum of 3-years'

- experience in manufacturer of such devices. Technology shall a hybrid of Silicone Avalanche Diodes and MOV or MOV and thermal fusing. GDT or sole MOV technology is not acceptable.
- e. Surge arrestor to include a dry contract for remote monitoring of a surge event.
 - f. Surge arrestor shall be installed per manufacturer recommendations, as close to incoming power as possible, and incoming leads shall be as short as possible.
 - g. Surge arrestor shall have a positive indication of device operation or failure.
 - h. Surge arrestor shall have a Surge Current rating of 25kA per phase.
 - i. Surge Arrestor shall be:
 - i. Weidmuller SPD series
 - ii. Citel DS40 series
 - iii. Or Equal
14. Analog I/O Surge Protection:
- a. Instruments: Surge protection shall be installed analog inputs and outputs for field instruments located outside of the building.
 - b. PLC I/O: Surge protection shall be installed analog inputs and outputs for signals transitioning to the exterior of the building in which the PLC is installed.
 - c. Surge arrestor shall be adequate for intended function and shall be by a nationally recognized manufacturer with a minimum of 3-years' experience in manufacturer of such devices. Technology shall be Hybrid or MOV, GDT technology is not acceptable.
 - d. Surge arrestor shall include protection for the shield.
 - e. Surge arrestor shall have a Surge Current rating of 5kA.
 - f. Surge Arrestor shall be:
 - i. Citel DLA series
 - ii. Weidmuller VSCP series
 - iii. Or Equal
15. Analog I/O Loop Fusing:
- a. Fuse all analog input and output loops individually.
 - b. Use 250ma ACG type fusing or equal.
16. Discrete I/O Surge Protection:
- a. Surge protection shall be installed discrete inputs and outputs for field instruments located outside of the building.
 - b. Surge arrestor shall be adequate for intended function and shall be by a nationally recognized manufacturer with a minimum of 3-years' experience in manufacturer of such devices. Technology shall be Hybrid or MOV, GDT technology is not acceptable.
 - c. Surge arrestor shall have a Surge Current rating of 5kA.
 - d. Surge Arrestor shall be:
 - i. Emerson DRS series
 - ii. Phoenix PT 2X1VA series
 - iii. Or Equal

17. Discrete I/O Fusing:
 - a. Fuse discrete inputs and outputs in logic groups of eight
 - b. Coordinate fuse rating with individual points and the rating required if all eight points were active.
 - c. Use MDA type fusing
18. AC Filter:
 - a. Provide a low pass EMI filter to protect PLC and instruments from high-frequency noise and low-energy transients.
 - b. Filtering shall only be provided on UPS powered circuits and located after the power supply.
 - c. Filter shall be sized for 125% of full load.
 - d. Filter shall attenuate both common and differential mode noise.
 - e. Attenuation: 30dB @100kHz
 - f. MTBF: >1 million hours
 - g. AC Filter shall be:
 - i. Sola STFV
 - ii. Islatrol/IC+
 - iii. Corcom
 - iv. Or Equal
19. Control Relays:
 - a. Scope: Control relays used for relay logic.
 - b. Relays shall be electrically held, Form C, electrically operated with 120 volt coils except as noted otherwise on the Drawings. Contacts shall be rated 10 amps at 600 volts.
 - c. The number of poles required shall be determined by the System Integrator depending on specific requirements of what the relay is used for. Each relay will be at minimum DPDT or one spare pole per relay.
 - d. Control relay shall have an energized indicator in either the form of a mechanical flag, or neon lamp (LED for DC applications).
 - e. Relays shall be provided with a suppression diode for inductive loads.
 - f. Control Relays shall be:
 - i. Allen Bradley 700-HF Series
 - ii. Idec RU Series
 - iii. Or equal
20. PLC Output Relays:
 - a. Scope: Control relays used for PLC outputs (isolation relays)
 - b. Each PLC discrete output shall be protected with an interposing relay including spare PLC discrete outputs. PLC output relays shall be SPDT electrically held, Form C, electrically operated with 120 volt coils. Contacts shall be rated at a minimum 5 amps at 300 volts. System Integrator shall use higher capacity relays for equipment that is being powered directly through the relay's contacts.
 - c. Control relay shall have an energized indicator in either the form of a mechanical flag, or neon lamp (LED for DC applications).
 - d. PLC output relays shall be DIN rail mounted and have a slim profile in order to conserve panel space.

- e. Relays shall be provided with a suppression diode for inductive loads.
 - f. Control Relays shall be:
 - i. Allen Bradley 700HK Slim Line Series
 - ii. Phoenix Contact PLC relay series
 - iii. Or equal
21. On Delay Time Delay Relays:
- a. An on delay time delay relay shall change the state of the relay contacts after the preset time delay from when control power is applied to the relay coil. Contacts shall immediately change state when control power is removed from the relay coil.
 - b. Delay timing relays shall be solid state, Form C, electrically operated with 120 VAC coils except as noted on the drawing.
 - c. The number of poles required shall be determined by the System Integrator depending on specific requirements of what the relay is used for. Each relay will be at minimum DPDT or one spare pole per relay.
 - d. Contacts shall be rated 5 amps at 240 volts.
 - e. Minimum time range shall be adjustable from 1 second to 1 minute. Other ranges as required by function and as indicated on the Drawings or within the Specifications.
 - f. On Delay Time Delay Relays shall be:
 - i. IDEC RTE Series
 - ii. Square D RE series
 - iii. Or Equal
22. Off Delay Time Delay Relay:
- a. An off delay time delay relay shall change the state of the relay contacts after the preset time delay from when control power is removed from the relay coil. Contacts shall immediately change state when control power is applied to the relay coil.
 - b. Delay timing relays shall be solid state, Form C, electrically operated with 120 VAC coils except as noted on the drawing.
 - c. The number of poles required shall be determined by the System Integrator depending on specific requirements of what the relay is used for. Each relay will be at minimum DPDT or one spare pole per relay.
 - d. Contacts shall be rated 5 amps at 240 volts.
 - e. Minimum time range shall be adjustable from 1 second to 1 minute. Other ranges as required by function and as indicated on the Drawings or within the Specifications.
 - f. Off Delay Time Delay Relays shall be:
 - i. IDEC GT3F Series
 - ii. Phoenix Contact ETB Series
 - iii. Or Equal
23. Interval Time Delay Relays:
- a. An interval delay time delay relay shall change the state of the relay contacts when control power is applied to the relay coil. Contacts shall change state after the set interval time period.

- b. Delay timing relays shall be solid state, Form C, electrically operated with 120 VAC coils except as noted on the drawing.
 - c. The number of poles required shall be determined by the System Integrator depending on specific requirements of what the relay is used for. Each relay will be at minimum DPDT or one spare pole per relay.
 - d. Contacts shall be rated 5 amps at 240 volts.
 - e. Minimum time range shall be adjustable from 1 second to 1 minute. Other ranges as required by function and as indicated on the Drawings or within the Specifications.
 - f. On Delay Time Delay Relays shall be:
 - i. IDEC RTE Series
 - ii. Magnecraft TDR Series
 - iii. Square D RE series
 - iv. Or Equal
24. Alternating Relay:
- a. A duplex cross-wired Alternating Relay shall alternate the load every time an initiating switch is opened.
 - b. The relay shall have two initiating inputs for lead / lag functionality.
 - c. The relay shall have two DPDT outputs rated for 120VAC at 3A.
 - d. Two LEDs shall indicate load position.
 - e. Control Voltage: 120VAC
 - f. Alternating Relay shall be:
 - i. Macromatic
 - ii. Time Mark
 - iii. Or Equal
25. Loss of Phase Relay:
- a. A phase loss relay shall monitor the status of the three phases of line power. The relay shall be rated for the line voltage of the motors.
 - b. The phase loss relay shall change the state of a contact when there is a loss of phase, phase unbalance, or undervoltage.
 - c. A status light shall be on the relay indicating relay status.
 - d. Contacts shall be DPDT and rated 5A at 120VAC.
 - e. The delays and trip points shall be adjustable and determined in the field.
 - f. Equal to:
 - i. Macromatic PMD series
 - ii. Eaton D65 series
 - iii. Or Equal
26. Terminal Blocks
- a. Field terminal strips with box type connectors shall be supplied to make all power and control connections to and from each control panel.
 - b. All terminals shall be clearly marked for easy identification. A ground terminal strip shall also be provided.
 - c. Field terminal blocks shall be single tier for ease of installation and maintenance.
 - d. At least 20 percent of terminals supplied shall be spare. All wiring in and out of a control panel shall be terminated on field terminal blocks.

- e. All spare PLC I/O (including interposing relays) shall be wired to terminal blocks.
 - f. Prewired terminal blocks from the control manufacturer as also acceptable, Allen Bradley IFM or equal. The prewired terminal blocks shall also meet the specifications herein.
 - g. Field Terminal Blocks shall be:
 - i. Phoenix Contact UT Series
 - ii. Allen-Bradley 1492 Series
 - iii. Or equal
27. DIN Rail
- a. Size: 35mm
 - b. Material: Aluminum or Bronze
 - c. All field terminal blocks shall be mounted on 2" raised DIN rail
28. Motor High Temp and Seal Fail Relay:
- a. Submersible pumps and dry pit submersible pumps will each be supplied with a relay system to detect a motor high temperature condition and seal fail condition. The pump manufacturer (or as indicated on drawings) will furnish the required relays and devices, for measuring these conditions, to the System Integrator. The System Integrator shall install these devices in the appropriate control panel as required per the Contract Documents.
29. Spare Parts and Test Equipment:
- a. The System Integrator shall furnish the following spare parts :
 - i. 2 surge suppressors of each type
 - ii. 1 24 VDC Power Supply
 - iii. 1 Uninterruptible Power Supply
 - iv. PLC Components - Refer to section 13442
 - v. 10 of each type lamp, unless otherwise specified herein
 - vi. 3 of each color indicator light lens.
 - vii. 1-time delay relay (of each type)
 - viii. 5 control relays (of each type)
 - ix. 1 complete selector switch of each type.
 - x. 1 complete push-button of each type.
 - xi. 1 complete speed potentiometer of each type
 - xii. 1 of each different contact block for control units.
 - xiii. 2 of every type of fuse.

PART 3 - EXECUTION

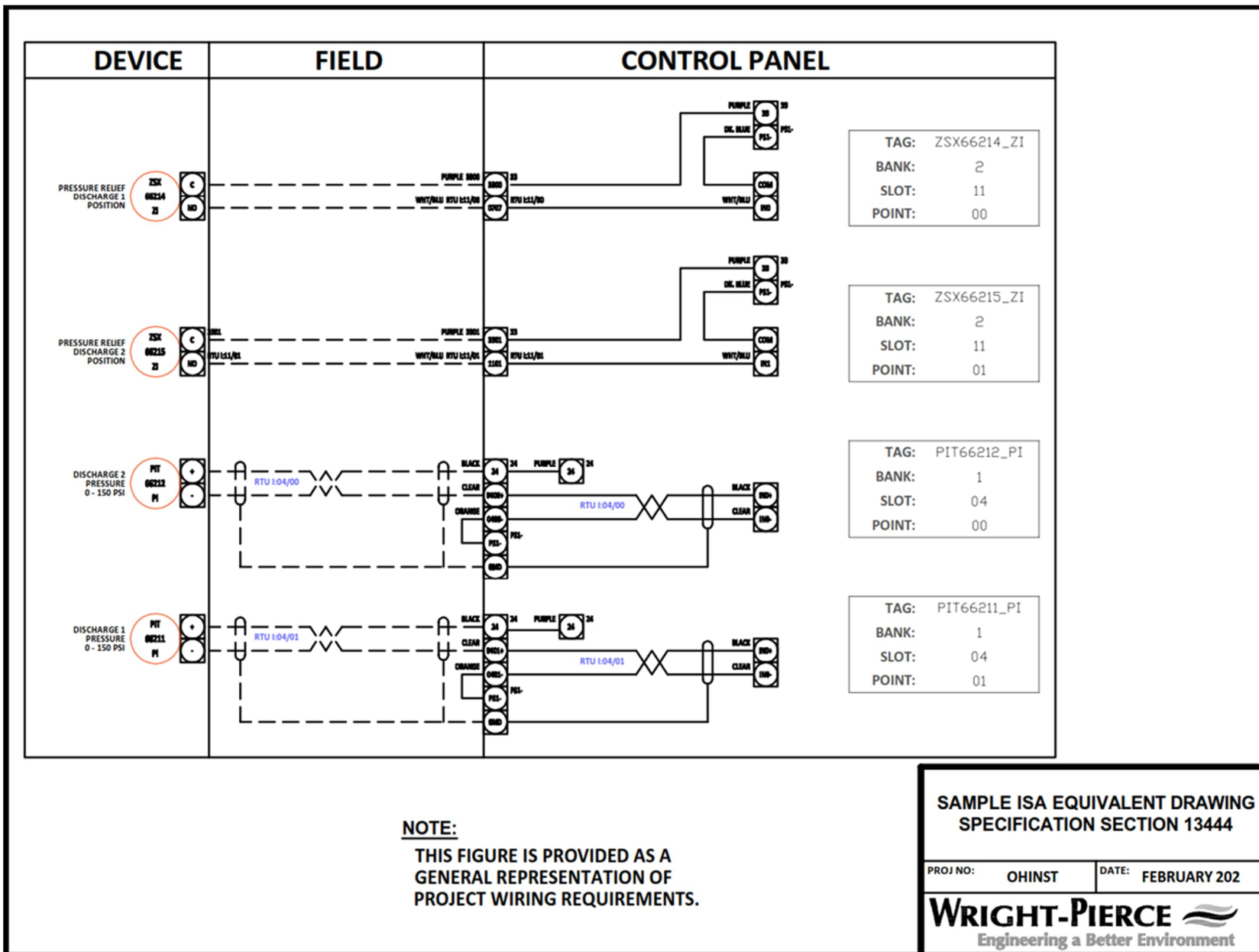
3.1 INSTALLATION

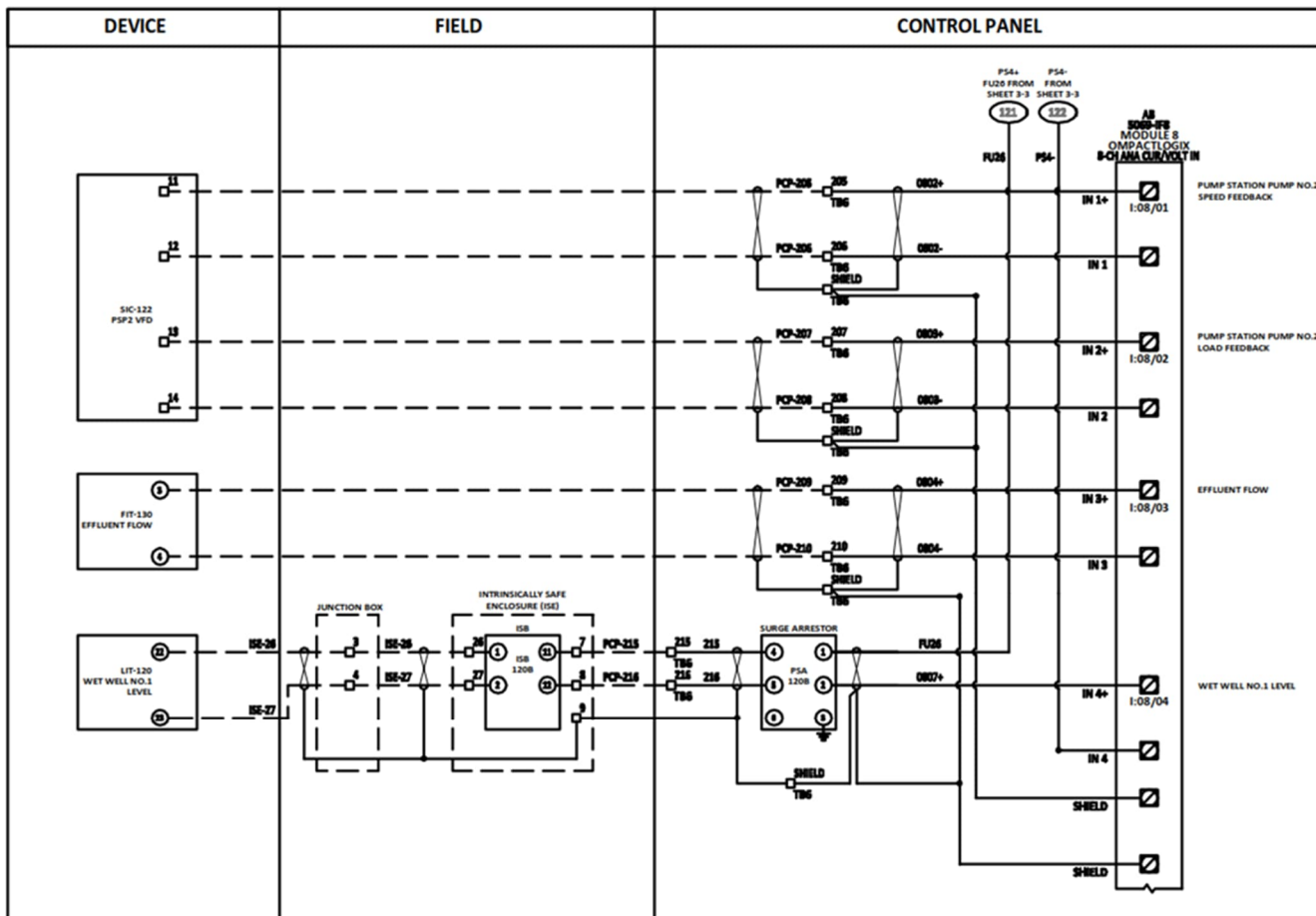
- A. General: Refer to Section 13440 PART 3 - EXECUTION.

PANEL SCHEDULE

<u>Description</u>	<u>Abbreviation</u>	<u>Type</u>	<u>NEMA Rating</u>	<u>Panel Width</u>	<u>Mounting</u>	<u>Shelf & Keyboard</u>	<u>Marshaling Shelf</u>	<u>UL Rating</u>
Old Norwich Road -Pump Control Panel-	PCP	CP	12	48"	Floor	No	No	508
Old Norwich Road OIT Panel	OIT-PCP	CP	12	"	Wall	No	No	508

SAMPLE ISA EQUIVALENT DRAWINGS





NOTE:

**THIS FIGURE IS PROVIDED AS A
GENERAL REPRESENTATION OF
PROJECT WIRING REQUIREMENTS.**

**SAMPLE ISA EQUIVALENT DRAWING
SPECIFICATION SECTION 13444**

PROJ NO: OHINST

DATE: FEBRUARY 202

WRIGHT-PIERCE 
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END OF SECTION

SECTION 13445

COMMUNICATION NETWORK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish, configure and test a new star Ethernet communication consisting of the following:
 - 1. Provide one (1) managed industrial Ethernet switch, and ancillary equipment in each pump station control panel to allow communication between:
 - i. The new PLC in the Old Norwich Road Pump Control Panel PCP, Power Monitoring and OIT-Panel using CAT6 cable. Switches shall be installed as shown on the Network Drawing and the Electrical Drawings.
 - 2. Provide, connect and test new CAT6 cables between each control panel Ethernet switch and the communications panel Ethernet switch as shown on the Network Drawing and the Electrical Drawings.
 - 3. Supervise the installation of CAT6 cables. Configure the new industrial Ethernet switches to communicate with each other.
- B. Related Work Specified Elsewhere.
 - 1. Instrumentation and Process Control: Section 13440
 - 2. Programmable Logic Controllers: Section 13442
- C. Tests and Procedures Prior to Start-up
 - 1. The CONTRACTOR shall secure the supervisory services of a factory-trained service engineer/technician who is specifically trained on the type of equipment specified herein, shall be provided during construction to assist the CONTRACTOR in methods of installing conduit and special cable; mounting, piping, and wiring of each de-vice, and the methods of protecting all of the equipment prior to placing it into service. Upon completion of the installation, provide the services of a trained service engineer/technician to configure, calibrate, test, and startup the equipment and provide instruction and training for the operating personnel. A sufficient number of service days shall be provided to place the system in satisfactory operation. One additional service call of one 8-hour working day (not including travel time) shall be included for use upon demand of the Owner within the first year's operation.
- D. Demonstration of the Complete Network System
 - 1. Final demonstrations shall be made only after the Engineer is satisfied that the work has been completed in accordance with the intent of the Contract Documents.
 - 2. After the Communication Network is completed, and when directed by the engineer, demonstrate that each of the communication ports on the network is functioning and make final adjustments to the system. If any system or piece of equipment within a system fails to function properly, rectify such defects or inadequacies and make a final demonstration as directed by the Engineer.

3. Provide the services of authorized manufacturers' representatives to instruct the Owner's representatives in the proper operation and maintenance of the system installed under this Contract.
4. Pay all charges or fees, including the cost of any special test equipment, factory engineers, etc., necessary for the proper performance of the specified tests, demonstrations and instructions.
5. All demonstrations and instructions referred to shall be scheduled at the convenience of the Engineer and the Owner and in no case shall be scheduled without at least seventy- two (72) hours written notice.

1.2 QUALITY ASSURANCE

- A. All materials provided under this Contract shall be equal in quality, appearance and performance to that specified herein and shall be subject to the approval of the Engineer. Verify the availability of all materials proposed to be used in the execution of the work prior to submitting same for the Engineer's approval. The discontinuance of production of any material or product after approval has been granted shall not relieve the Contractor from furnishing an Engineer approved alternate of comparable quality and design without additional cost.
- B. Materials and equipment furnished under this Contract shall be standard products of manufacturers regularly engaged in the manufacture of such products and shall be the manufacturer's latest standard design that complies with Specification requirements. Products shall essentially duplicate material and equipment that have been in satisfactory local use at least three years.
- C. The Network Supplier shall have supplied comparable systems to those specified herein and shall maintain engineering and service departments capable of designing and maintaining these systems. Provide, for a period of twelve (12) months from the date of final acceptance of the work, all necessary supervision, labor, materials, and equipment, in order to correct any defects in any system due to faulty materials, equipment, or workmanship and consequent damage resulting from such defects. This work shall be scheduled during normal working hours and at the convenience of the Owner.
- D. Network Supplier:
 1. The communication network shall be furnished by one supplier, who shall provide all of the equipment and appurtenances regardless of manufacturer and be responsible to the Owner for satisfactory operation of the entire system.
 2. All necessary provisions will be made to ensure a proper interface between the existing control systems and new control panels provided under separate contracts.
- E. Acceptable Suppliers:
 1. NIC Systems Corp., Cromwell, CT
 2. Aaron Associates, Waterbury, CT
 3. Electrical Installations Inc., Moultonborough, NH
 4. Or equal, having a minimum of 5 years' experience in supplying comparable systems.

1.3 SUBMITTALS TO THE ENGINEER

- A. Shop Drawings and Samples:

1. Submit Shop Drawings in accordance with General Conditions Section 01340 and as indicated herein.
2. Shop Drawings shall be thoroughly checked for compliance with the Contract Documents. Verify that all furnished equipment and materials will fit into available space and maintain specified clearances, and that all equipment is compatible with the system operation.
3. Shop Drawings shall consist of:
 - a. Project name and location
 - b. Contractor's name
 - c. Index Sheet - Listing the equipment being submitted utilizing equipment designations, or symbols, indicated on the Contract Documents together with the proposed manufacturer, style/type and catalog number.
 - d. Manufacturer's scale or dimensioned drawings along with standard catalog number.
 - e. Equipment ratings, service clearances and configuration.
 - f. Bill of Materials and listing of accessories to be furnished.
 - g. Single-line and schematic diagrams of all required piping and electrical work.
 - h. Layout diagrams of the network communication panels, electrical schematics, terminal block loop diagrams, and point to point network diagrams.
 - i. Provide network diagrams complete with all network panels, control panels, CAT6 patch panels, communication switches, firewalls, computers, and ancillary network equipment. All equipment on the network shall be identified by equipment tags as indicated on the Contract Network Diagram. Each cable (copper) and jumper (copper) shall be identified including specific ports or channels in which they are connected. This submittal shall be provided as part of the initial submittals early in the project for approval by the Engineer. After installation, testing, and acceptance of the Network by the Engineer, the Network Supplier shall resubmit as part of closeout O&M documentation per as-built field conditions. If the existing network is modified as part of an upgrade, the system provider (system integrator) shall investigate and document the entire communication network.
4. All material shall be contained in one submission.
5. Submissions shall be in the form of a binder. Each equipment type shall be separated by index tabs with typewritten titles.
6. Provide samples of instruments, devices, graphics, etc., within ten (10) days upon receipt of request from the Engineer.
- B. Maintain properly documented and witnessed test and checkout reports and submit these to the Engineer. No form of energy shall be applied to any part of the communication system prior to receipt by the Engineer of the supplier's certified statement of approval of the installation and containing their authorization to energize the system, except that the supplier's technician may do so for the purpose of check-out as described herein.
- C. Upon completion of the work and before request for final payment, deliver to the

Engineer six (6) bound sets of full and complete directions pertaining to the operation and maintenance of all equipment and systems installed under this Contract. These directions shall be on 8-1/2" x 11" sheets neatly bound with index tabs, and shall be accompanied by plans, diagrams, etc., of the work installed, parts lists, etc., necessary for the guidance of the Owner in operating, altering or repairing the installation. In addition to the foregoing, furnish the Engineer with a written statement from the Owner indicating that they are satisfied with the operating instructions given.

- D. Provide the Owner with a list of local service departments of duly authorized distributors of materials and equipment of the type installed, which will stock the manufacturer's standard parts, etc.
- E. At the completion of the installation, provide reproducible Record Drawings indicating the final configuration of all systems as they were installed. Symbols, equipment designations, etc., shall be consistent with the Contract Documents. Provide exact locations of all work which has been concealed in concrete, masonry or underground.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Coordinate material and equipment delivery with the project schedule. Notify the Engineer immediately, in writing, if material or equipment delivery will adversely affect the project schedule, include documentation from equipment suppliers indicating the revised delivery dates and the reason for the delay.
- B. Coordinate delivery of equipment directly to other vendors where instrumentation supplied under this section shall be installed in panels supplied under other specification sections.
- C. Exercise care during loading, transporting, unloading and handling of materials to prevent damage.
- D. Check for defective or damaged materials, and for incomplete equipment shipments within seven (7) days after equipment delivery to the project site.
- E. Store materials and equipment on the construction site in enclosures or under protective covering in order to assure that materials and equipment are kept undamaged, clean and dry.
- F. Replace or repair, to the satisfaction of the Engineer, all materials and equipment that are defective or that have been damaged during installation, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 COMMUNICATION NETWORK

- A. General:
 - 1. Provide PLC communication network to allow communication between:
 - i. The new PLC in the Old Norwich Road PCP, Operator interface terminals (OITs), Power Monitoring and other Ethernet devices as shown on the Network Diagram Drawings.
 - 2. The network will use Ethernet protocol and meet 10/100BaseT IEEE 802.3 (UTP) and 100Base-FX multimode (fiber optic) standards.
 - 3. The network equipment will be mounted at each location shown on Drawing I-2. The following Manufacturer furnished control panels will be connected to

the PLC network and will be supplied with the required communications equipment:

- a. Old Norwich Road Pump Control Panel (PCP)
- b. Old Norwich Road Pump OIT Panel (OIT-PANEL)

2.2 MANAGED ETHERNET SWITCHES

A. General

1. Provide Managed Ethernet Switches for connection to the control network backbone as shown in the Drawings and specified herein.
2. All Managed Ethernet Switches to be sized with 25% spare ports (minimum of 1 spare) beyond what is required to provide the intended design functionality. The following table below lists the Managed Ethernet Switches and the minimum number of ports required to produce the design intent. Note that this table accounts for the required spare capacity assuming a network topology as shown on the Control System Architecture Drawings. Any submitted network architecture equipment differing from the Drawings and Specifications must meet spare ports requirement and the Managed Ethernet Switch Schedule below.

B. Physical Features

1. Copper ports: Refer to Network Schedule at the end of this section.
2. PoE ports: Refer to Network Schedule at the end of this section.
3. Operating temperature: -20 to 130 °F
4. Power: 24 VDC redundant power supply inputs
5. Enclosure:
 - a. 19" Rack Mountable, for switches to be mounted in 19" SCADA Server Rack, as shown on the Drawings.
 - b. Metal case, DIN-rail mountable, for all other switches, as shown on the Drawings.
6. Rating: UL Class 1, Division 2 Groups A, B, C, and D
7. Reliability: MTBF >2million hours

C. Network Features

1. Fault tolerant for use in a hybrid ring topology as shown on drawings
 - a. Ring topology shall utilize the G.8032 standard
2. Full duplex on all ports
3. Auto negotiation and manual configurable speed and duplex
4. Wire speed switching fabric
5. IEEE 802.1w RSTP
6. IGMP snooping
7. IGMP filtering
8. Configuration password protected
9. Configuration backup capability required
10. SNMP V3

D. Additional Features

1. The switch shall come equipped with a dry contact rated for 120 VAC 5A that shall be used for common trouble alarm. Contact shall be Normally Closed, open on alarm. The alarm shall be programmable. If the contact cannot use 120

VAC 5A, provide the necessary 24 VDC power from the PLC panel and provide interposing relays in the PLC panel.

- E. Acceptable Manufacturers
 - 1. N-Tron – 700/7000/9000 Series
 - 2. Hirschmann
 - 3. Moxa
 - 4. Or Equal
- F. Basis of design: The drawings are based on generic network equipment. Equivalent alternate equipment (ex. SFP ports, PoE switch in lieu of PoE injectors) will be considered provided that all revisions required to the design, including but not limited to power supplies, be accomplished at no cost to the owner.

2.3 WIRES AND CONNECTORS

- A. Ethernet 10/100/1000 BASE-T/TX Cable.
 - 1. The unshielded twisted pair (UTP) cable shall be designed for use with a high speed (10/100/1000 Mbps) Ethernet 10/100/1000 BASE-T/TX communications network. The twisted pair cable shall have a nominal impedance 100 ohms at one MHz, a maximum attenuation of 8 dB per 1000 feet at one MHz. The twisted pair cable must have frequency tested up to 250 MHz or more. The twisted pair cable shall be plenum rated and shall have a minimum of four 23 AWG solid copper conductor pairs. All 10/100/1000 BASE-T/TX (RJ-45) terminations on the twisted pair cable shall be done in a professional and workman like manner. Terminations shall provide for proper strain relief on the cable jacket. Strain relief on the wire and/or wire insulation shall not be acceptable.
 - 2. Identification: Control Panels and networks racks shall use color coded patch cables:
 - a. Primary Process Layer: Blue
 - b. Secondary Process Layer: Gray
 - c. SCADA Layer: Green
 - d. Admin Layer: Yellow
 - e. Security Layer: Red

2.4 SPARE PARTS

- A. General requirements for spare parts are specified in section 13300.
- B. The following Network and Communications System spare parts shall be furnished
 - 1. One media converter of each type provided
 - 2. Manufacturer's cables - one of each type installed.
 - 3. Two-10ft CAT 6 patch cables of every color with connectors installed

2.5 NETWORK SCHEDULE

ID Tag	Description	Location	Power Supply	10/100TXRJ45 Ports	10/100FX Ports (SC Type)*	10/100/1000TX RJ45 Ports	10/100/1000SX/LX Ports (LC Type)*	PoE RJ45 Ports	Managed	Mounting
MES-PCP	Ethernet Switch	PCP-Old Norwich Road	24VDC	8	4	0	0	0	Yes	DIN
ES-OIT	Ethernet Switch	OIT-Panel- Old Norwich road	24VDC	4	0	0	0	0	No	DIN

END OF SECTION

- L. Submit complete piping drawings for each piping submittal indicating type of hanger and/or support, location, magnitude of load transmitted to the structure and type of anchor, guide and other pipe supporting appurtenances including structural fasteners.
- M. Submittal shall include catalog cut for each different type of pipe hanger or support indicating the materials of construction, dimensions and range of pipe sizes for which that hanger is suitable. Where standard hangers and/or supports are not suitable, submit detailed drawings showing materials and details of construction for each type of special anchor and/or support.
- N. Summary of Contractor selected related components including joints, class, valves, appurtenances, etc., and commercial supports and piping materials.
- O. Coordinate piping support arrangements to eliminate interference with similar systems to be installed under HVAC, Plumbing, Fire Protection and Electrical; to account for structural expansion joints and to maintain access for both personnel and for removal of equipment.
- P. After the work is installed, but before it is filled for start-up and testing, the support system design engineer shall inspect the work and certify its complete adequacy. Each system shall be inspected and certified in the same way. Submit a report, including all field modifications and all certificates.

1.4 SEISMIC CONTROL

- A. Not applicable.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Exercise care during loading, transporting, unloading, and handling to prevent damage of any nature to interior and exterior surfaces of pipe and fittings.
- B. Do not drop pipe and fittings.
- C. Store materials on the project site in enclosures or under protective coverings in accordance with manufacturer's recommendations and as required by the Engineer.
- D. Assure that materials are kept clean and dry.
- E. Do not store materials directly on the ground.
- F. Follow manufacturer's specific instructions, recommendations and requirements.
- G. Store in a manner to protect items with epoxy shop coatings from exposure to UV light which can cause chalking of the epoxy. Length of acceptable exposure prior to providing UV protective measures shall be in accordance with coating manufacturer's recommendations. This includes protection from UV light after installation while awaiting covering or filling of tanks, or prior to field painting for items scheduled to be topcoated as specified in Section 09900.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials are specified in the following Sections in this Division.

2.2 BOLTS, ANCHOR BOLTS AND NUTS

- A. Furnish all necessary bolts, anchor bolts, nuts, washers, lock washers or locking nuts, plates and bolt sleeves in accordance herewith. Anchor bolts shall have suitable

- washers, lock washers and, where so required, their nuts shall be hexagonal.
- B. All bolts, anchor bolts, nuts, washers, lock washers, plates, and bolt sleeves shall be carbon steel unless otherwise indicated below or as specified elsewhere.
 - 1. Stainless steel hardware (minimum of Type 304, unless otherwise indicated) is required in all corrosive atmospheres, exterior areas, and/or areas with NEMA 4X or NEMA 7 rating.
 - 2. Stainless steel hardware (minimum of Type 316, unless otherwise indicated) is required in all submerged applications as well as in wetwells, headworks, dewatering rooms, chemical rooms, clarifiers, aeration basins, splitter structures, equalization or storage tanks, etc. For additional description and definition of submerged surfaces refer to Specification Section 09900.
 - C. Unless otherwise specified, stud, tap, and machine bolts shall be of the best-quality refined bar iron. Hexagonal nuts of the same quality of metal as the bolts shall be used. All threads shall be clean cut and shall conform to AN Standard B 1.1-1974 for Unified Inch Screw Threads (UN and UNR Thread Form).
 - D. All bolts shall be suitable size for the intended purpose, with direct input from the product manufacturer.

2.3 SURFACE PREPARATION AND SHOP COATINGS

- A. Provide surface preparation and shop coatings in accordance with Specification Section 09905.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Provide all labor necessary to assist the Engineer to inspect pipe, fittings, gaskets, and other materials.
- B. Carefully inspect all materials at the time of delivery and just prior to installation.
- C. Carefully inspect all pipe and fittings for:
 - 1. Defects and damage.
 - 2. Deviations beyond allowable tolerances for joint dimensions.
 - 3. Removal of debris and foreign matter.
- D. Examine areas and structures to receive piping for:
 - 1. Defects, such as weak structural components that adversely affect the execution and quality of work.
 - 2. Deviations beyond allowable tolerances for pipe clearances.
- E. All materials and methods not meeting the requirements of this Contract will be rejected.
- F. Immediately remove all rejected materials from the project site.
- G. Start work only when conditions are corrected to the satisfaction of the Engineer.

3.2 INSTALLATION

- A. General:
 - 1. Install all pipe and fittings in strict accordance with the manufacturer's instructions and recommendations and as specified herein.

2. Install all pipes and fittings in accordance with the lines and grades shown on the Drawings and as required for a complete installation.
 3. Install adapters, acceptable to the Engineer, when connecting pipes constructed from different materials.
 4. Support all piping not being installed in trenches in accordance with the "Pipe Hangers & Supports" Section in Division 15.
- B. Installation in Trenches:
1. Firmly support the pipe and fittings on bedding material as shown on the Drawings and as specified in the appropriate Sections of these Specifications.
 2. Do not permanently support the pipe or fittings on saddles, blocking stones, or any material which does not provide firm and uniform bearing along the outside length of the pipe.
 3. Thoroughly compact the material under the pipe to obtain a substantial unyielding bed shaped to fully support the pipe.
 4. Excavate suitable holes for the joints so that only the barrel of the pipe receives bearing pressure from the supporting material after placement.
 5. Lay each pipe length so it forms a close joint with the adjoining length and bring the inverts to the required grade.
 6. Set the pipe true to line and grade.
 7. Do not drive the pipe down to grade by striking it with a shovel handle, timber, rammer, or any other unyielding object.
 8. Immediately after making a joint, fill the holes for the joints with bedding material, and compact.
 9. When each pipe length has been properly set, place and compact enough of the bedding material between the pipe and the sides of the trench to hold the pipe in correct alignment.
 10. After filling the sides of the trench, place and lightly tamp bedding material to complete the bedding as shown on the Drawings.
 11. Take all necessary precautions to prevent floatation of the pipe in the trench.
 12. Bedding and backfill for all pipe materials shall be as specified in Section 02200, Earthwork, and as shown on the Drawings.
- C. Temporary Plugs:
1. When pipe installation work in trenches is not in progress, close the open ends of the pipe with temporary watertight plugs.
 2. If water is in the trench when work is resumed, do not remove plugs until all danger of water entering the pipe is eliminated.
 3. Do not use the pipelines as conductors for trench drainage during construction.

3.3 CLEANING AND TESTING

- A. Cleaning & Testing Piping - General:
1. Thoroughly clean all piping prior to testing. Remove all dirt, dust, oil, grease and other foreign material. Exercise care while cleaning to avoid damage to linings and coatings.
 2. When the installation is complete, test all pipelines in the presence of the Engineer and the plumbing or building inspector in accordance with the requirements of the local and state plumbing codes and the appropriate Sections

of these Specifications, at no additional cost to the Owner. When requested by the Engineer or local plumbing inspector, building gravity drains shall be tested prior to backfilling or concealing. All other piping must be tested after backfilling.

3. Equipment: Supply all labor, equipment, materials, taps, gauges, and pumps required to conduct the tests.
4. Retesting: Perform all retesting required by the Engineer at no additional cost to the Owner.
- B. Building Interior or Exposed Water Lines: Clean and test in accordance with the "Plumbing General" Section in Division 15.
- C. Building Interior or Exposed Sewer System: Clean and test in accordance with the "Plumbing General" Section in Division 15.
- D. Outside Sewer Lines (CLASS II): CLASS II pipe testing shall be performed in accordance with Section 02755.
- E. All Other Piping Systems:
 1. CLASS IV and CLASS V Hydrostatic Pressure Test:
 - a. The section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. If blowoffs are not available at high points for releasing air the Contractor shall make the necessary excavations, backfilling and taps at such points and shall plug said holes after completion of the test.
 - b. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
 - c. CLASS IV - Perform pressure and leakage test at the test pressure shown on the Pipe Schedule. If no test pressure is indicated, perform pressure and leakage test at 1-½ times the maximum system pressure or 100 psi whichever is greater (based on the elevation of the lowest point of the section under test and corrected to the gauge location).
 - d. CLASS V - Perform pressure and leakage test at the test pressure shown on the Pipe Schedule. If no test pressure is indicated, perform pressure and leakage test at 1-1/2 times the maximum system pressure or 20 psi whichever is greater (based on the elevation of the lowest point of the section under test and corrected to the gauge location).
 - e. While maintaining this pressure, the Contractor shall make a leakage test by metering the flow of water into the pipe. If the average leakage during a two-hour period on buried pipelines exceeds a rate calculated by the equation in paragraph 3.3,B,1,e of this Specification Section, the section shall be considered as having failed the test. All pipes within structures and chambers and all flanged joints shall have no visible leakage.
 - f. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at their own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.
 2. Connection to Work by Others.

- a. If work involves connection of pipe lines to pipes or structures provided by others, pressure tests pipe line prior to making the connection.
 - b. After successfully passing the pipe line pressure test, make the necessary connections to the work by others, and pressure test the connection.
 - c. The connection shall be pressurized to the pipe line test pressure, for a minimum of 4 hours. The connection shall have no visible leakage.
 - d. Correct any leakage at no cost to the Owner and retest until connection passes.
3. Cleaning: Perform all specialized cleaning as specified or required by system.

3.4 PIPE SCHEDULE

TAG	DESCRIPTION	LOCATION (1)	SIZE	MATERIAL (2)	JOINT SYSTEM	PRESSURE TEST CLASS (3)	DELEGATED PE DESIGN OF PIPE SUPPORTS (4)	DELTA OPER. PRESS. (PSI)	DELTA OPER. TEMP. (degF)
FM	SEWER FORCE MAIN SUCTION & DISCHARGE	BURIED	≥4"	CLASS 52 D.I.	MJ OR PUSH-ON	CLASS IV	N/A	-	-
			<4"	SDR 26 PVC	PUSH-ON		N/A	-	-
		EXPOSED	≥8"	CLASS 53 D.I.	FLANGED		YES	150	40
			≤6"	CLASS 53 D.I.	FLANGED		NO	-	-
CW/ CWX	DOMESTIC COLD WATER	ALL	ALL	SEE SPEC SECTION 15401		NO	-	-	
G / GX	NATURAL GAS	ALL	ALL	SEE SPEC SECTION 15401 AND 15444		NO	-	-	
HW/ HWX/ HWRX	DOMESTIC HOT WATER	ALL	ALL	SEE SPEC SECTION 15401		NO	-	-	
HWS / HWR	HEATING HOT WATER	ALL	ALL	SEE SPEC SECTION 15601		NO	-	-	
S/SX	SANITARY	ALL	ALL	SEE SPEC SECTION 15401		NO	-	-	
SPD	SUMP PUMP DISCHARGE	SEE PART 1 OF THIS TABLE							
V/VX	SANITARY VENT	ALL	ALL	SEE SPEC SECTION 15401		NO	-	-	
W/WX	WASTE	ALL	ALL	SEE SPEC SECTION 15401		NO	-	-	

(1) PIPE CONTAINED WITHIN TANKAGE SHALL BE CONSIDERED "EXPOSED" OR "INTERIOR" PIPING FOR THE PURPOSES OF THE PIPE SCHEDULE (UNLESS OTHERWISE SPECIFICALLY DESIGNATED).

(2) TYPE L COPPER MAY BE USED IN LIEU OF D.I. FOR 3" DUCTILE IRON PIPE.

(3) IF A SPECIFIC PRESSURE IS NOT INDICATED IN PARENTHESES AFTER THE PRESSURE TESTING CLASS,

USE THE TEST PRESSURE INDICATED IN THE SPECIFICATION WRITE UP FOR THAT GENERAL PIPE PRESSURE TESTING CLASS.

- (4) REFER TO SECTION 15094 FOR PIPE SUPPORT REQUIREMENTS AND SUBMITTALS. ALL EXPOSED PIPES REQUIRE SUPPORTS; SOME PIPES REQUIRE PIPE SUPPORTS, BRACING OR RESTRAINTS DESIGNED BY A PROFESSIONAL ENGINEER.

END OF SECTION

SECTION 15062

DUCTILE IRON PIPE & FITTINGS (INTERIOR/EXPOSED APPLICATIONS)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Provide and install ductile iron pipe and fittings of the type(s) and size(s) in the location(s) shown on the Drawings and as specified herein.
- B. Related Work Specified Elsewhere:
 - 1. Pipe and Pipe Fittings - General is specified in Section 15050.
 - 2. Surface Preparation and Shop Coatings are specified in Section 09905.

1.2 QUALITY ASSURANCE

- A. Standards (As Applicable):
 - 1. Cement-mortar lining for water: ANSI A21.4 (AWWA C104).
 - 2. Rubber gasket joints: ANSI A21.11 (AWWA C111).
 - 3. Ductile iron pipe thickness: ANSI A21.50 (AWWA C150).
 - 4. Ductile iron pipe centrifugally cast in metal or sand lined molds: ANSI A21.51 (AWWA C151).
 - 5. Pipe flanges and fittings: ANSI B16.1 and ANSI A21.10 (AWWA C110).
 - 6. Threaded, flanged pipe: ANSI A21.15 (AWWA C115).
 - 7. Cast and ductile iron fittings: ANSI A21.10 (AWWA C110).
 - 8. Ductile Iron Compact Fittings: ANSI 21.53 (AWWA C153).
- B. Acceptable Manufacturers:
 - 1. Tyler Union
 - 2. US Pipe
 - 3. Victaulic Company (fittings only, where allowed)
 - 4. Or equivalent.

1.3 SUBMITTALS TO THE ENGINEER

- A. In accordance with the requirements specified in Section 01340 and 11000. Submit such shop drawings, manufacturer's literature, short-term and long-term storage requirements, and operations and maintenance manuals.
- B. Additional specific information for submittal is listed below:
 - 1. Submit Manufacturer's "Certification of Conformance" that pipe and fittings meet or exceed the requirements of these specifications.
 - 2. Submit Manufacturer's installation instructions for all pipe and fittings.

1.4 DELIVERY, STORAGE & HANDLING

- A. Exercise extra care when handling cement lined pipe because damage to the lining will render it unfit for use.
- B. Protect the spherical spigot ends and the plain ends of all pipe during shipment by wood lagging securely fastened in place.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. General:

1. Unless otherwise shown on the Drawings, the minimum thickness of ductile iron pipe shall be Class 53.
2. Pipe for use with sleeve type couplings shall have plain ends (without bells or beads) cast or machined at right angles to the axis.
3. Pipe for use with split type couplings shall have ends with cast or machined shoulders or grooves that meet the requirements of the manufacturer of the couplings and AWWA C606.
4. The outside of all interior pipe shall be coated in accordance with Section 15050.

B. Pipe Interior Lining:

1. Pipe shall be double thickness cement lined and seal coated unless noted otherwise on the Drawings and except for air piping lines which shall be completely unlined.
2. When required, glass lining shall meet the following requirements:
 - a. Glass lining shall be fused to metal base by firing entire pipe or fitting to a temperature above 1,400 degrees F and held at that temperature for sufficient time to develop a smooth vitreous lining which has a molecular bond to the metal.
 - b. Glass lining shall be a minimum of 0.008-inch thick and shall be capable of withstanding an instantaneous thermal shock of 350 degrees F temperature differential without crazing, blistering or spalling. Lining shall be free of pinholes which expose the metal.
 - c. Glass lining shall have a hardness of 5-6 on the Mohs scale and a density of 2.5 to 3.0 grams per cubic centimeter.

C. Joints (as shown on Drawings or as specified):

1. Flanged:
 - a. Provide specially drilled flanges when required for connection to existing piping or special equipment.
 - b. Flanges shall be flat face, long-hub screwed tightly on pipe by machine at the foundry prior to facing and drilling.
 - c. Gaskets:
 - i. Full face gaskets only.
 - ii. Thickness of gaskets - Use standard 1/8-inch thickness gaskets, unless thinner gaskets are required for tight retrofit installations.
 - iii. On high temperature applications such as air lines, the gaskets shall be suitable for service from 40°F to 250°F.
 - d. Fasteners:
 - i. Make joints with bolt, studs with a nut on each end, or one tapped flanged with a stud and nut.
 - ii. The number and size of bolts shall meet the requirements of the applicable ANSI standard.
 - iii. Nuts, bolts, and studs shall be Grade B meeting the requirements

of ASTM A307.

- e. When applicable, provide and install flange clamps as shown on the Drawings.
- 2. Grooved Joint Couplings: Couplings shall consist of two or more ductile iron housing segments to ASTM A536, pressure responsive FlushSeal gasket to ASTM D2000, and zinc electroplated steel bolts and nuts to ASTM A449 or stainless steel to ASTM F593.
 - a. For direct connection to grooved end IPS/steel pipe sizes transition couplings may be used. The coupling housings shall be cast with offsetting angle-pattern bolt pads for joint rigidity.
 - b. Split ring couplings, sleeve couplings, flexible joints and couplings, shall be supplied as specified in "Couplings and Connectors" Section.
 - c. All grooved joint couplings, fittings, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 - d. All castings used for coupling housings, and fittings shall be date stamped for quality assurance and traceability.
- 3. Joint Bracing:
 - a. Provide joint bracing to prevent the piping from pulling apart under pressure as required and as shown on the Drawings.
 - b. Types of bracing:
 - i. Pipe and fittings furnished with approved lugs or hooks cast integrally for use with socket pipe clamps, tie rods, or bridles. Bridles and tie rods shall be a minimum of 3/4 inch diameter except where they replace flange bolts of a smaller size, in which case they shall be fitted with a nut on each side of the pair of flanges. The clamps, tie rods, and bridles shall be coated with bituminous paint in buried installations and shall be coated with the same coatings as the piping system in interior installations after assembly or, if necessary, prior to assembly.
 - ii. Other types of bracing as shown on the Drawings.

2.2 FITTINGS

A. Standard Fittings:

- 1. Either gray cast iron or ductile iron fittings may be furnished.
- 2. Pressure rating of 250 psi unless indicated otherwise on the Drawings or as specified.
- 3. Flange fittings shall be ANSI B16.1, Class 125 unless indicated otherwise. Flanges shall be flat faced, with full face gaskets.
- 4. Grooved end fittings shall comply with ANSI A21.10/AWWA C110 for center-to-end dimensions, and ANSI A21.10/AWWA C110 or AWWA C153 for wall thickness. Ends shall comply with AWWA C606, and the fittings shall be of the same manufacturer as the grooved components.
- 5. Joints the same as the pipe with which they are used or as shown on the Drawings.
- 6. Provide fittings with standard bases where shown on the Drawings.

7. Cement lining and seal coat unless noted otherwise on the Drawings, and except for air piping applications where the fittings shall be unlined.
8. All interior fittings shall receive coating in accordance with Section 15050.
9. On high temperature applications such as air lines, the gaskets shall be suitable for service from 40°F. to 250° F.
- B. Non-Standard Fittings:
 1. Fittings having non-standard dimensions shall be subject to the Engineer's review and acceptance.
 2. Non-standard fittings shall have the same diameter and thickness as standard fittings and shall meet the specification requirements for standard fittings.
 3. The lengths and types of joints shall be determined by the particular piping to which they connect.
 4. Flanged fittings not meeting the requirements of ANSI A21.10 (i.e., laterals or reducing elbows) shall meet the requirements of ANSI B16.1 in Class 125.
- C. Wall Castings:
 1. Size, type and location as shown on the Drawings.
 2. Dimensions shall conform to ANSI A21.10 except where required. A flange substantially flush with the face of a concrete or masonry wall shall be drilled and tapped for studs.
 3. Other dimensions shall be identical to the corresponding parts of standard bell and spigot fittings.
 4. An intermediate sealing and anchoring collar not less than 0.38-inch thick up to 36-inch diameter pipe and not less than 0.5-inch thick for 42-inch diameter pipe and larger. The intermediate sealing and anchoring collar to be the same diameter as a flange shall be cast on the barrel at a point that will locate it midway through the wall to form a waterstop.
 5. Alternate wall sleeve system as manufactured by Omni Sleeve, Malden, MA can be utilized as approved by Engineer, in place of above specified wall casting system.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Provide all labor necessary to assist the Engineer to inspect pipe, fittings, gaskets, and other materials.
- B. Carefully inspect all materials at the time of delivery and just prior to installation.
- C. Carefully inspect all pipe and fittings for:
 1. Defects, such as weak structural components, that adversely affect the execution and quality of work.
 2. Deviations beyond allowable tolerances for pipe clearances.
- D. Immediately remove all rejected materials from the project site.

3.2 INSTALLATION

- A. General:
 1. Install in strict accordance with the pipe and fitting manufacturer's instructions and recommendations and as specified or as shown on the Drawings.

2. Acceptable thrust resistant system is required at all fittings on pressure pipe.
- B. Assembling Joints:
1. Flanged Joints:
 - a. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
 - b. Execute care when tightening joints to prevent undue strain upon valves, pumps, and other equipment.
 2. Grooved Joints:
 - a. Grooved joint shall be installed in accordance with the manufacturer's written recommendations.
 - b. Grooved ends shall be clean and free from indentations, projections, or roll marks.
 - c. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service.
 - d. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor's representative is not considered qualified to conduct the training.)
 3. Bolted Joints:
 - a. Remove rust preventive coatings from machined surfaces prior to assembly.
 - b. Thoroughly clean and carefully smooth all burrs and other defects from pipe ends, sockets, sleeves, housings and gaskets.
 - c. All stainless steel fasteners for piping and supports shall be hand tightened to limit the potential for galling.
- C. Fabrication:
1. Tapped Connections:
 - a. Make all tapped connections as shown on the Drawings or as required by the Engineer.
 - b. Make all connections watertight and of adequate strength to prevent pullout.
 - c. Drill and tap normal to the longitudinal axis of the pipe.
 - d. The maximum sizes of taps in pipes and fittings without busses shall not exceed the sizes listed in the appendix of ANSI A21.51 based on 3 full threads for ductile iron.
 - e. Taps in fittings shall be located where indicated by the manufacturer for that particular type of fitting.

- D. Castings in Masonry:
1. Accurately set and align castings to be encased in masonry.
 2. Thoroughly clean castings immediately prior to being set in place. Remove all rust, scale and other foreign material.

END OF SECTION

SECTION 15063

COPPER PIPE & FITTINGS (INTERIOR APPLICATIONS)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish and install copper pipe and fittings of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified herein.
- B. Related Work Specified Elsewhere:
 - 1. Pipe & Pipe Fittings - General is specified in this Division.

1.2 QUALITY ASSURANCE

- A. Pipe: Seamless copper water tube, ASTM B88 (pressure) and ASTM B-306 atmospheric.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe Use (When Applicable):
 - 1. Domestic water (interior).
 - a. Type L, soft annealed, 1 inch and smaller.
 - b. Type L, hard temper, 1-1/4 inches and larger.
 - 2. Process fluids, compressed air, vacuum, inert gas, general use and where indicated (interior).
 - a. Type L, hard temper.
 - 3. Fuel oil piping (where indicated):
 - a. Type L soft temper.
- B. Fittings:
 - 1. Wrought copper and bronze solder joint pressure fittings: ANSI B16.22.
 - 2. Cast bronze solder joint pressure fittings: ANSI B16.18.
 - 3. Cast bronze solder joint drainage fittings: ANSI B16.23.
 - 4. Cast bronze fittings for flared copper tubes: ANSI B16.26.
- C. Solder and Flux:
 - 1. Solid string or wire solder, 95 percent tin, 5% antimony on all pressure piping and potable water.
 - 2. Silver solder, 45% brazing silver alloy (where indicated).
 - 3. Flux: Non-corrosive paste type as required for type of solder.
 - 4. Acid core, paste type, or solder/flux combinations are not permitted.
 - 5. Solder or flux containing lead in any form will not be permitted on any potable water system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Jointing:

1. Solder Joints:
 2. Ream or file pipe to remove burrs.
 3. Clean and polish contact surfaces of all joints.
 4. Apply flux to both male and female ends.
 5. Insert ends of tubes into fittings, the full depth of the sockets.
 6. Bring the joints to soldering temperature in as short a time as possible.
 7. Form continuous solder beads around the entire circumferences of the joints.
- B. Bending Pipe:
 1. Bend pipe by the method and to the radius to comply with the manufacturer's recommendation.
 2. Bends shall be free of any cracks or buckles.
- C. Support: Support all pipes in accordance with the "Pipe Hangers & Supports" Section in this Division.
- D. To permit convenient disassembly for alterations and repairs, install unions where shown on the Drawings and:
 1. In long runs of piping,
 2. In bypasses around equipment,
 3. In connections to traps, tanks, pumps, and other equipment,
 4. Between shutoff valves, and
 5. In other locations as directed by the Engineer.
- E. Remove all valve internals when soldering into pipelines.

END OF SECTION

SECTION 15088

COUPLINGS & CONNECTORS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish and install couplings and connectors of the type(s) and size(s) in the location(s) shown on the Drawings and as specified herein.
- B. Related Work Specified Elsewhere: "Pipe & Pipe Fittings - General" is specified in this Division.

1.2 QUALITY ASSURANCE

- A. Minimum pressure rating equal to that of the pipeline in which they are to be installed.
- B. Couplings and connectors, other than those specified herein, are subject to the Engineer's approval.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All Couplings and Connectors:
 - 1. Gasket Materials: Composition suitable for exposure to the liquids to be contained within the pipes.
 - 2. Diameters to properly fit the specific types of pipes on which couplings and connectors are to be installed.
- B. Sleeve Type Couplings (When Applicable):
 - 1. Exposed Couplings (When Applicable):
 - a. Steel middle ring,
 - b. Two steel follower rings,
 - c. Two wedge-section gaskets,
 - d. Sufficient steel bolts to properly compress the gaskets,
 - e. Acceptable Manufacturers:
 - i. Smith-Blair – Style 411
 - ii. Romac – Style 400
 - iii. Baker Hughes (GE Company) – Style 38
 - iv. Or equal
 - 2. Buried Couplings (When Applicable):
 - a. Cast iron or epoxy coated steel middle rings with pipe stops removed,
 - b. Two malleable iron or epoxy coated steel follower rings with ribbed construction,
 - c. Two wedge-section gaskets,
 - d. Sufficient AWWA C-111 or galvanized steel nuts and bolts to properly compress the gaskets,
 - e. Acceptable Manufacturers:
 - i. Smith Blair – Style 411
 - ii. Romac – Style 501

- iii. Or equal.
- C. Split Type Couplings (When Applicable):
 - 1. Constructed from malleable or ductile iron.
 - 2. For use with grooved or shouldered end pipe with minimum wall thickness as required so as not to weaken pipe.
 - 3. Cast in two segments for 3/4 inch through 14 inch pipe sizes, four segments for 15 inch through 24 inch pipe sizes, and six segments for pipe sizes over 24 inch.
 - 4. Coating: Enamel.
 - 5. Bolts: Carbon steel.
 - 6. All gaskets shall be Manufacturers Standard or as required for intended service with respect to fluid, temperature and pressure.
 - 7. Acceptable Manufacturers:
 - a. Victaulic Company of America, Style 77 for IPS Pipe, Style 31 for Ductile Iron Pipe.
 - b. Star Pipe Products,
 - c. Or equal.
- D. Flanged Adapters (When Applicable):
 - 1. For joining plain end or grooved end pipe to flanged pipes and fittings.
 - 2. Adapters shall conform in size and bolt hole placement to ANSI standards for steel and/or cast iron flanges 125 or 150 pound standard unless otherwise required for connections.
 - 3. Exposed Sleeve Type:
 - a. Constructed from steel.
 - b. Coating: Enamel.
 - c. Bolts: Carbon steel or ASTM A588 steel.
 - d. Acceptable Manufacturers:
 - i. Dresser Manufacturing Co. - Style 128 for cast iron, ductile iron and steel pipes with diameters of 2 inches through 96 inches,
 - ii. Smith Blair
 - iii. Or equal.
 - 4. Buried Sleeve Type:
 - a. Constructed from cast iron.
 - b. Bolts: ASTM A588 steel or galvanized steel.
 - c. Acceptable Manufacturers:
 - i. Dresser Manufacturing Co. - Style 127 locking type for cast iron, ductile iron, asbestos cement and steel pipes with diameters of 3 inches through 12 inches,
 - ii. Smith Blair
 - iii. Or equal.
 - 5. Split Type:
 - a. Constructed from malleable or ductile iron.
 - b. For use with grooved or shouldered end pipe.
 - c. Coating: Enamel.
 - d. Acceptable Manufacturers:
 - i. Victaulic Company of America - Style 741 for IPS pipe, or Style 341 for Ductile Iron Pipe, for pipe diameters of 2 inches through 12

- inches,
 - ii. Victaulic Company of America - Style 742 for IPS pipe, or Style 342 for Ductile Iron Pipe, for pipe diameters of 14 inches through 16 inches,
 - iii. Star Pipe Products,
 - iv. Or equal.
- E. Flexible Joints:
- 1. Expansion Joints (Liquid Service):
 - a. Materials shall be capable of withstanding the temperature, pressure and type of material in the pipeline.
 - b. Shall be the filled arch type that will prevent sediment build up for all sludge, sewage, and other lines with similar service.
 - c. Supplied with control rods to restrict elongation and compression.
 - d. Metal retaining rings shall be split and beveled galvanized steel for placement against the flange of the expansion joint.
 - 2. Expansion Joint (Air Service)
 - a. Rubber expansion joints for all low pressure process air piping shall be of the non-filled arch double bellow type, unless otherwise noted.
 - b. The expansion joint shall have ANSI 125-pound flanges.
 - c. All low pressure process air piping rubber expansion couplings shall be capable of withstanding a pressure of 15 psig at a temperature of 250°F.
 - d. Rubber expansion couplings shall be as manufactured by General Rubber Corp., Mercer Rubber Co., or equal.
 - 3. Deflection Joints:
 - a. Joints designed to permit a nominal maximum deflection of 15 degrees in all directions from the axis of the adjacent pipe length, will prevent pulling apart, and will remain watertight at any angle of deflection under 15 degrees.
 - b. Material to be manufactured from a composition material suitable for exposure to the liquid, pressure and temperature to be contained within the pipe.
 - c. Supplied with control rods as required.
- F. Dismantling Joints:
- 1. Service: Provide flexibility for installation and dismantling of flanged pipe interfaces with valves, pumps, blowers, meters, compressors and various appurtenances.
 - 2. Restraint: Tie rods.
 - 3. Size: 4" to 24"
 - 4. Finish: Epoxy
 - 5. Double-ended flange adapter capable of 2 to 20 inches longitudinal adjustment.
 - 6. Pressure: Minimum 150 pound design working pressure, or match pipe rating, whichever greater.
 - 7. Fabricated steel body, welded construction.
 - 8. Materials: flange carbon steel, body carbon steel; follower ductile iron for 12" and less and carbon steel for 14" and larger; wedge gasket Buna-S or Buna-N and suitable for fluid.

9. Connection: 150 pound ANSI flanges welded to spool piece and flange adapter.
10. Acceptable Manufacturer:
 - a. Dresser Style 131
 - b. Smith Blair Model 975
 - c. Or equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Sleeve Type Couplings (When Applicable):
 1. Thoroughly clean pipe ends for a distance of 8 inches from the ends prior to installing couplings, and use soapy water as a gasket lubricant.
 2. Slip a follower ring and gasket (in that order) over each pipe and place the middle ring centered over the joint.
 3. Insert the other pipe length into the middle ring the proper distance.
 4. Press the gaskets and followers evenly and firmly into the middle ring flares.
 5. Insert the bolts, finger tighten and progressively tighten diametrically opposite nuts uniformly around the adapter with a torque wrench applying the torque recommended by the manufacturer.
 6. Insert and tighten the tapered threaded lock pins.
 7. Insert the nuts and bolts for the flange, finger tighten and progressively tighten diametrically opposite bolts uniformly around the flange to the torque recommended by the manufacturer.
- B. Split Type Flange Adapters (When Applicable): Install in the same manner as Split Type Couplings.
- C. Buried Cast Iron Couplings, Adapters and Connectors (When Applicable): Thoroughly coat all exterior surfaces, including nuts and bolts, after assembly and inspection by the Engineer with a heavy-bodied bituminous mastic as approved by the Engineer.
- D. Buried Epoxy Coated Steel Couplings: Thoroughly coat all exterior surfaces, including nuts and bolts after assembly and inspection by the Engineer with a coal tar approved by the Engineer. Prior to coating, roughen the epoxy with emory paper and follow with a solvent cleaner (aeromatic similar to xylol). Dry film thickness of the coal tar is to be 12-16 mils.
- E. Install thrust rods, supports, and other provisions to properly support pipe weight and axial equipment loads.
- F. All interior sleeve type couplings shall be restrained with tie rods when used on pressurized lines. All buried couplings on pressure lines shall be restrained (solid sleeve) type.

END OF SECTION

SECTION 15092

PIPE SLEEVES & SEALS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish and install wall sleeves and seals of the type(s) and sizes(s) and in the location(s) shown on the Drawings and specified herein.
- B. Related Work Specified Elsewhere:
 - 1. Sealants are specified in Section 07920.
 - 2. Pipe and Pipe Fittings - General is specified in Section 15050
 - 3. Plumbing - General is specified in Section 15400.
 - 4. HVAC - General is specified in Section 15600.

1.2 QUALITY ASSURANCE

- A. Provide and install all sleeves of the types specified herein, as shown on the Drawings and as directed by the Engineer.
- B. Provide sleeves that are airtight, gastight or watertight as required.
- C. Penetrations through fire rated walls, floors and ceiling shall have proper fire stopping, as specified in Section 07270.

PART 2 - PRODUCTS

2.1 TYPES AND LOCATIONS

- A. General
 - 1. Refer to details on Process Drawings.
- B. Penetrations through New Construction:
 - 1. Interior Masonry, Drywall, or Wood Partition (Non-Load Bearing) - Air to Air:
 - a. 24 gauge, zinc coated (galvanized) steel tubes with wired or hemmed edges.
 - b. Minimum 1/4 inch annular space between sleeve and pipe or insulation.
 - c. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.
 - d. Install split cover plates in all finished areas. Both sides of wall if required. Plates shall be chrome finished, suitably sized to fit pipe in question and cover opening.
 - 2. Exterior Masonry and Wood Walls
 - a. Schedule 40 galvanized steel pipe, hot-dip galvanize after fabrication.
 - b. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness.
 - c. Minimum 1/4-inch annular space between sleeve and pipe or insulation.
 - d. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.

3. Interior Concrete Partitions - Air to Air:
 - a. Schedule 40 galvanized steel pipe with 1 inch x 1/8 inch thick welded sealing and anchoring collar in middle, hot-dip galvanize after fabrication. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness.
 - b. Minimum 1/4 inch annular space between sleeve and pipe or insulation.
 - c. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.
 - d. Refer to details on Process Drawings.
4. Concrete Floor Penetrations - Air to Air; and Air to Ground:
 - a. Same as "Interior Concrete Partitions - Air to Air".
 - b. Pipe sleeve to extend 2 inches above finished floor.
 - c. Pipe sleeve bottom to be set flush with underside of slab.
 - d. Galvanized steel pipe riser clamp with threaded rod embedded into concrete floor to be installed on topside of penetration to support the pipe vertically.
 - e. Refer to details on Process Drawings.
5. Roof Penetrations - Air to Air:
 - a. Same as "Interior Concrete Partitions" and as shown on the Drawings.
6. Exterior Concrete Walls - Air to Air; and Air to Ground:
 - a. Schedule 40 galvanized steel pipe with 1 inch x 1/4 inch integrally cast sealing and anchoring collar in middle, hot-dip galvanize after fabrication. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness.
 - b. Size of pipe sleeve as required by seal manufacturer.
 - c. Seal with rubber link compression seal.
 - d. Alternate wall sleeve system as manufactured by Omni Sleeve, Malden, MA can be utilized as reviewed and accepted by Engineer, in place of above specified wall sleeve system.
 - e. Refer to details on Process Drawings.
7. Concrete Tank Walls - Liquid Containing Structures to Air, Ground, or Liquid
 - a. For ductile iron and steel piping systems, utilize wall castings, or sleeve and double rubber link compression seal. Materials, schedule, class and size to match pipe.
 - i. For galvanized steel piping systems, use SCH 40 galvanized steel pipe with 1-inch x 1/4-inch welded sealing and anchoring collar in middle, hot-dip galvanized after fabrication. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness.
 - ii. For stainless steel piping systems, use Schedule 40 stainless steel pipe with 1-inch x 1/4-inch welded sealing and anchoring collar in middle. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness.
 - iii. For ductile or cast iron piping systems, use wall casting with 1-inch x 1/4-inch integrally cast sealing and anchoring collar in middle; or sleeve with 1-inch x 1/4-inch welded sealing and anchoring collar

- in middle, hot-dip galvanized after fabrication.
- iv. Refer to details on Process Drawings.
- b. For plastic piping systems, sleeve and seals to be in accordance with “Exterior Concrete Walls - Air to Ground” requirements noted above. These type penetrations will be allowable only in those locations specifically depicted on the drawings.
- 8. Foundation Walls Below Grade - Ground to Ground:
 - a. Schedule 40 or max. 3/8 inch thick wall galvanized steel sleeve. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness.
 - b. Minimum 1/2 inch annular space.
 - c. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.
- 9. Other conditions shall be sleeved or as reviewed and accepted by the Engineer.
- C. Penetrations Through Existing Construction:
 - 1. Interior masonry, drywall, or wood partition - Air to Air:
 - a. Cleanly cut brick or block as required. Grout sleeve into place using non-shrink grout.
 - b. Cleanly cut wood frames partitions as required. Set sleeve into position and secure.
 - c. Sleeves to be as required for New Construction - Interior masonry, drywall, or wood partition - Air to Air.
 - d. Holes bored with equipment leaving a smooth hole in masonry walls less than 1/2 inch larger than the pipe will not require a sleeve, unless otherwise specified.
 - e. Minimum 1/4 inch annular space between cored opening or sleeve and pipe or insulation.
 - f. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.
 - g. Install split cover plates in all finished areas. Both sides of wall if required. Plates shall be chrome finished, suitably sized to fit pipe in question and cover opening.
 - 2. Interior Concrete Partitions - Air to Air:
 - a. Core smooth-walled opening with coring machine. Grout sleeve into place using non-shrink grout.
 - b. Sleeves to be as required for “New Construction - Interior Concrete Partitions - Air to Air”.
 - c. Holes cored with equipment leaving a smooth hole, less than 1/2 inch larger than the pipe will not require a sleeve, unless otherwise specified.
 - d. Minimum 1/4 inch annular space between cored opening or sleeve and pipe or insulation.
 - e. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.
 - 3. Interior Concrete Partitions - Air to Air:
 - a. Same as “Exterior Concrete Wall”.
 - 4. Interior Concrete Partitions - Air to Air (Unclassified to Classified):

- a. Same as “Concrete Tank Wall”.
5. Exterior Masonry Walls
 - a. Core drill a smooth hole through all layers of the existing masonry. Hole shall be sized to facilitate standard rubber link compression seal installation.
 - b. Install rubber link compression seal at each layer of masonry.
 - c. Seal each face with polyurethane sealant.
 - d. If a clean, smooth hole cannot be achieved, remove the masonry as required to install Schedule 40 galvanized wall sleeve. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness. Grout sleeve in place. Install rubber link compression seal and sealant as noted above.
6. Exterior Wood Walls
 - a. Remove existing siding and other materials, as required to install the new item.
 - b. Restore the wall and siding to provide a weather-tight seal acceptable to the Engineer.
7. Concrete Floor Penetrations - Air to Air:
 - a. Same as “Interior Concrete Partitions - Air to Air”, except that sleeve will not be required.
 - b. Stainless steel pipe riser clamp with stainless steel threaded rod embedded into concrete floor to be installed on topside of penetration to support the pipe vertically.
 - c. Install rubber link compression seal, as shown, covered by self-leveling sealant (SikaFlex or equivalent).
 - d. Refer to details on Process Drawings.
8. Roof Penetrations - Air to Air:
 - a. Same as “Interior Concrete Partitions - Air to Air” and as shown on the Drawings.
9. Concrete Exterior Walls - Air to Ground:
 - a. Core smooth-walled opening with coring machine. Grout smooth any irregularities in opening.
 - b. Size of cored opening as required by seal manufacturer.
 - c. Seal with rubber link compression seal.
10. Concrete Tank Walls - Liquid Containing Structures to Air or Ground:
 - a. Core smooth-walled opening with coring machine. Grout smooth any irregularities in opening.
 - b. Size of cored opening as required by seal manufacturer.
 - c. Seal with two, back to back rubber link compression seals.
11. Foundation Walls Below Grade - Ground to Ground:
 - a. Core smooth-walled opening with coring machine. Grout sleeve into place using non-shrink grout.
 - b. Sleeves to be as required for “New Construction - Foundation Walls Below Grade - Ground to Ground”.
 - c. Holes cored with equipment leaving a smooth hole, less than 1-inch larger than the pipe will not require a sleeve, unless otherwise specified.

- d. Minimum 1/2 inch annular space between cored opening or sleeve and pipe or insulation.
 - e. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.
 - 12. Other conditions shall be installed as reviewed and accepted by the Engineer.
- D. Pipe openings in and penetrations through precast concrete structures shall be as specified in Division 2 and 3.
- E. Rubber Link Compression Seals:
 - 1. Acceptable Manufacturers:
 - a. Link Seal
 - b. Flexicraft
 - c. Or equivalent.
 - 2. Multi-rubber link type with pressure plates, bolts, nuts and sealing element providing a leak proof seal. Model numbers provided below are based on Link Seal and are to establish type and level of quality.
 - 3. General Service (Model C):
 - a. Glass Reinforced Nylon Pressure Plate.
 - b. Carbon steel zinc-dichromate nut and bolt.
 - c. Sealing element: EPDM rubber.
 - d. Temperature Rating: -40°F to 250°F.
 - 4. Corrosive Service: (Model S-316):
 - a. Use in the following locations: Sludge tanks, scum tanks, digesters, wetwells, manholes, dewatering rooms, headworks rooms, exterior tanks, chemical rooms, as shown on the Drawings.
 - b. Glass Reinforced Nylon Pressure Plate.
 - c. Bolt and nut, 18-8 stainless steel.
 - d. Sealing element: EPDM rubber.
 - e. Temperature Rating: -40°F to 250°F.
 - 5. Potable/Clean Water Service (Model S61)
 - a. Blue reinforced Nylon polymer pressure plates.
 - b. 316 stainless steel nuts and bolts.
 - c. Sealing element: Black EPDM NSF 61 certified.
 - d. Temperature Rating: -40° to 250° F.
 - e. Certified to NSF/ANSI standard 61.
 - 6. High Temperature Service (Model T)
 - a. Steel zinc dichromate pressure plates.
 - b. Carbon steel with zinc dichromate finish nuts and bolts.
 - c. Sealing element: Silicone.
 - d. Temperature Rating: -67° to 400° F.
 - 7. Refer to details on Process Drawings.
- F. Wall Plates: Provide split type cast iron or brass wall plates on pipes penetrating walls in finished spaces such as labs and offices. Refer to details on Process Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. New construction:
 - 1. Concrete: Set sleeves in proper location prior to placing concrete. Sleeves set by mechanical, plumbing, and HVAC trades as appropriate.
 - 2. Masonry: Mechanical, plumbing, and HVAC trades to provide sleeves and locations to masonry trades for installation.
 - 3. Partitions: Set sleeves in place as work progresses.
- B. Hollow Concrete Roof or Floor Planks:
 - 1. Provide planks with sleeve cast-in-place at time of construction,
 - 2. Or core drill planks in location reviewed and accepted by Engineer and plank manufacturer. Submit written approval of locations from pre-cast concrete plank manufacturer.
 - 3. Firmly grout sleeve in place.
- C. Existing Construction:
 - 1. The location will be reviewed and accepted by the Engineer prior to coring or cutting hole.
 - 2. For concrete, holes shall be located to avoid the reinforcing steel when possible.
 - 3. Patch all damaged work as required to maintain a neat and clean appearance.
- D. Rubber Link Compression Seals: Install as required and in strict accordance with the manufacturer's instructions and recommendations.

END OF SECTION

SECTION 15094

PREFABRICATED PIPE HANGERS, SUPPORTS AND BRACING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Design, furnish and install prefabricated pipe hangers, supports, and braces to support pipes, maintain the necessary pitch, minimize vibration, prevent movement, and allow expansion and contraction of the pipes shown on the Drawings, as specified in Section 15050, as specified herein and as referenced. Supports shall be designed for all tributary gravity loads and lateral loads from operating pressures, seismic forces, and startup/shutdown water hammer thrust. This Specification covers hangers, supports, and braces for process and mechanical piping systems including ductile iron, carbon steel, galvanized steel, stainless steel, fiberglass, PVC and copper piping.
- B. Hangers for electrical conduit, plumbing piping, HVAC ducts, and other utilities are found within their respective Specification sections.

1.2 RELATED SECTIONS

- A. Section 07920 - Joint Sealants
- B. Section 09900 – Painting
- C. Division 11 – Equipment
- D. Section 15050 – Pipe and Pipe Fittings – General
- E. Pipe, pipe fittings and valves are specified in respective sections of Division 15.

1.3 REFERENCES

- A. This section contains references that are applicable to this Specification Section. The applicable edition of the indicated references shall be the version that was the most current at the time of the Advertisement of Bids.
- B. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - 1. MSS SP-58 Pipe Hangers and Supports – Materials, Design and Manufacture
 - 2. MSS SP-69 Pipe Hangers and Supports – Selection and Application
 - 3. MSS SP-89 Pipe Hangers and Supports – Fabrication and Installation Practices
 - 4. MSS SP-90 Guidelines on Terminology for Pipe Hangers and Supports
- C. ASTM A123/A123M - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron & Steel Products
- D. ASTM A153/A153M - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- E. ASTM C881/C881M - Specification for Epoxy-Resin-Base Bonding Systems for Concrete
- F. ASCE 7 – Minimum Design Loads for Buildings and Other Structures
- G. International Building Code (2009)
- H. 2005 Connecticut State Building Code with 2005 Connecticut Supplement and 2009 Amendments.

1.4 DESIGN REQUIREMENTS

- A. Contractor shall provide all necessary hangers, supports and braces as needed to provide a fully functional and adequately supported and restrained system.
- B. This Specification requires the delegated design of pipe hangers, supports and bracing. The performance criteria, design requirements and materials of construction are specified herein. Refer to the Structural Drawings for a list of prohibited and allowed structural components from which piping can be hung, supported or braced. The absence of specific pipe support details shall not relieve the Contractor of the responsibility for designing and providing a fully functional system meeting the requirements of this Specification. Specification Section 15050 identifies which piping systems will and will not require a pipe support design by a Professional Engineer.
- C. Prefabricated pipe supports shall be provided for all pipes shown on the Contract Drawings. Unless otherwise indicated, the terms “pipe support”, “pipe hanger” and “pipe guide” shall refer to prefabricated pipe supports, hangers, guides, and braces specified herein.
- D. The term “Pipe Support Design Engineer” shall refer to the Professional Engineer hired by the General Contractor to design the pipe support system.
- E. All structural steel pipe support frames and shop fabricated pipe support assemblies shown on the Contract Drawings are specified elsewhere and not required as part of this Specification.
- F. Pipes supports shall be classified as one of the following:
 - 1. Type 1 – Supported from an overhead structural member using overhead hangers, guides, clevises, rollers, clamps or other means as specified herein.
 - 2. Type 2 - Supported from a structural member below the pipe using guides, rollers, clamps, saddles or other means as specified herein.
 - 3. Type 3 – Supported from an adjacent wall or other vertical structural member using brackets with either Type 1 supports or Type 2 supports or other means as specified herein.
 - 4. Type 4 – Miscellaneous Pipe Hangers, Supports and Braces not specifically identified above.
 - 5. Additionally, each pipe support shall be classified as one of the following based on function:
 - a. Type S - Simple Support
 - b. Type G - Guide Support
 - c. Type F - Fixed Support
- G. Where flexible joints or couplings are indicated on the Contract Drawings at equipment, tanks, etc., the end opposite to the piece of equipment, tank, etc., shall be rigidly supported, to prevent transfer of system forces to the equipment. No fixed or restraining supports shall be installed between a flexible joint or coupling and the piece of equipment.
- H. All pipe and appurtenances connected to the equipment shall be supported in a manner to prevent any strain or load from being imparted on the equipment or piping system.
- I. Pipe supports shall be provided to minimize forces through valves, split and sleeve type couplings, flexible expansion joints and to minimize all pipe forces on equipment housings. Equipment housings shall not be utilized to support connecting pipes.

- J. Unless otherwise indicated on the Drawings, maximum hanger and support spacing shall not exceed the following:
1. Copper Pipe:
 - a. 1" diameter and smaller – 5 feet
 - b. 1 1/4", 1 1/2" and 2" diameter – 7 feet
 - c. Greater than 2" diameter – 9 feet
 2. Steel and Stainless Steel Pipe:
 - a. 2" diameter and smaller – 7 feet
 - b. 2 1/2" - 4" diameter – 11 feet
 - c. 5" – 8" diameter – 16 feet
 - d. Greater than 10" diameter – 22 feet
 3. Ductile and Cast Iron Pipe:
 - a. All diameters – 10 feet
 4. PVC and FRP Pipe:
 - a. Hanger and support spacing shall be as recommended by the pipe manufacturer based on pipe size and service temperature. Individually supported PVC pipes shall be supported as recommended by the manufacturer except that support-spacing shall not exceed 3-feet.
 5. The maximum support spacings listed above are based on the specific pipes being full of liquid without any additional vertical loads or thrusts. The actual required support spacings may be limited to the hangers selected or the presence of additional loads.
 6. Supports shall be spaced such that the resulting concentrated load at any suspended (Type 1) support does not exceed 2,000 pound maximum and combined load shall not exceed 25 pounds per square foot over each slab panel the supports extend into, or as indicated on the Structural Drawings.
 7. Pipe alignment guides shall not be used as vertical support of the piping.
 8. Wall penetration sleeves (link-seal type or equivalent) shall not be used as support of the piping.
- K. Contractor shall provide pipe supports at the following locations:
1. At all locations indicated on the Contract Drawings.
 2. At all locations such that the maximum support spacing listed above are not exceeded.
 3. At all locations such that the allowable load capacity of the prefabricated hangers are not exceeded.
 4. At the end of all pipe runs.
 5. At all changes in pipe direction greater than 22 degrees.
 6. Within 1 foot of all valves, couplings, expansion joints and pipe joints.
 7. All other locations deemed necessary by the Contractor, Pipe Support Design Engineer or pipe manufacturer.
 8. Spaced such that the deflection in the pipe under operating conditions does not exceed $L/360$, where L is the distance between supports.
- L. All drilled anchors used in suspended Type 1 and Type 3 pipe supports shall meet the following requirements:
1. All supports shall have a minimum of 2 anchors per support.

2. Anchors shall be sized such that the ultimate capacity of the anchor is a minimum of 5 times greater than the anticipated design forces (Minimum Factor of Safety of 5).
 3. Anchors shall have a minimum embedment depth of 6 inches, minimum spacing of 6 inches and a minimum edge distance of 6 inches.
 4. Concrete anchors shall either be the epoxy adhesive or expansion anchor type.
 5. Masonry anchors shall either be the epoxy adhesive or expansion anchor type. Masonry cells shall be grouted at the anchors. Drop-in, Toggle or epoxy anchors with screen tubes shall not be permitted.
- M. All pipe supports shall be designed for the following loads:
1. Dead loads (including cement lining, insulation, etc)
 2. Liquid Density – use a liquid specific gravity of 1.10 for water, wastewater and sludges and use the appropriate liquid specific gravity for chemicals, unless otherwise noted
 3. Operational Thrust – refer to Specification Section 15050
 4. Water Hammer Thrust – refer to Specification Section 15050
 5. Thermal forces – refer to Specification Section 15050
 6. Wind Load – In accordance with ASCE 7.
 7. Snow Load – In accordance with ASCE 7.
 8. Ice Load – In accordance with ASCE 7.

1.5 SUBMITTALS

- A. Submit a complete set of shop drawings of all items to be furnished under this Section and as required by Section 01340 and 15050.
- B. For piping systems that require delegated design by a Professional Engineer, submit experience statement from the proposed Pipe Support Design Engineer to demonstrate compliance with the following criteria prior to submitting any technical information.
 1. Engage the services of an independent registered Professional Engineer ordinarily engaged in the business of pipe support systems analysis, to analyze system piping and service conditions and to develop a detailed support system, specific to the piping material, pipe joints, valves and piping appurtenances proposed for use. The proposed Pipe Support Design Engineer shall have at least 5 years of experience in the analysis and design of similar systems, including the use of commercial and custom pipe support and in the use of commercial pipe stress software programs. Firms meeting these criteria include: Newman Associates, LLC., Canton, MA; Waterford Associate Inc., East Providence, RI, SAC Incorporated, Williston, VT; NEFCO Tech Sales, East Hartford, CT or equivalent. The professional engineer shall be registered in the State of Connecticut.
- C. Technical submittals for all projects shall include the following information:
 1. Layout drawings with all pipe supports clearly labeled, located, and coordinated with the tabulated list noted below. Layout drawings shall include both Plan and Section views with the pipe supports clearly labeled in each view. All pipe layout changes proposed by the General Contractor shall be incorporated in the layout and identified as a proposed modification. Layout drawings shall

address gravity loads and dynamic loads including thermal effects, pressure thrusts and seismic forces.

2. Summary of Pipe Hangers, Supports and Bracing: Submit a tabulated list of pipe support information which includes the following information at a minimum:
 - i. Hanger/Support/Brace Number
 - ii. Location
 - iii. Pipe Diameter (nominal ID)
 - iv. Pipe centerline elevation
 - v. Pipe material
 - vi. Additional dead weight (Cement lining, insulation, etc)
 - vii. Lineal foot dead weight of pipe
 - viii. Contents of pipe
 - ix. Total lineal foot weight (dead weight and live weight)
 - x. Length of pipe tributary to support
 - xi. Total gravity and dynamic load at support
 - xii. Type of support (as identified in Section 1.4.B above)
 - xiii. Fixity of support (as identified in Section 1.4.B above)
 - xiv. Structure supporting pipe support (Section 1.4.F above)
 3. Representative catalog cut for each different type of pipe hanger, brace, or support indicating the materials of construction, material finishes, pipe sleeve or insulation information, protective shields, important dimensions and range of pipe sizes for which that hanger is suitable. Where standard hangers and/or supports are not suitable, submit detailed drawings showing materials and details of construction for each type of special hanger and/or support.
 4. Representative catalog cuts for accessories (e.g., threaded rod, insulation shields and saddles, never-seize compound, etc.)
 5. Letter from the General Contractor stating that the following has been coordinated:
 - i. Each pipe support system will not interfere with the other pipe support or seismic bracing systems.
 - ii. Components from the pipe support systems shall not extend within any means of egress or walking pathways in building spaces or at tanks.
 - iii. Components from the pipe support systems shall not interfere with the normal maintenance or operation of a component or equipment.
- D. Supplemental technical submittals for projects which require a Pipe Support Design Engineer, as identified in Section 15050, shall include the following information:
1. Completed Certificate of Design (included at the end of this Section).
 2. Dead weight and dynamic load analysis, including system thermal effects and pressure thrusts. Computer-based software system equivalent to ADLPIPE or Autopipe. Each piping system shall be presented in an isometric graphic and shall show the resolved and resultant force and moment systems, as well as all recommended hangers, supports, anchors, restraints and expansion/flexible joints.

3. After the work is installed, but before it is filled for start-up and testing, the Pipe Support Design Engineer shall inspect the work and shall certify its complete adequacy. Submit documentation for each piping system to demonstrate the inspection and certification of adequacy.
- E. After the installation is completed and certified, submit as-built drawings for record purposes.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All uninsulated non-metallic piping such as PVC, CPVC, etc., shall be protected from local stress concentrations at each support point. Protection shall be provided by pipe insulation shields or other methods after review with no exceptions taken by the Engineer. All shields shall cover the pipe where it is in contact with the support.
- B. All insulated pipe shall be furnished with a pipe insulation shield and/or saddle at each pipe support location as specified herein.
- C. Where pipe hangers and supports come in contact with copper piping, provide protection from galvanic corrosion by wrapping pipe with 1/16-inch thick neoprene sheet and galvanized protection shield; isolators similar to Eleen, Figure No. 228; or PVC-coated hangers and supports. All stainless steel piping shall be isolated from all ferrous materials, including galvanized steel, by use of neoprene sheet material and protection shields, similar to above methods.
- D. Pipe supports PVC piping:
 1. Pipe supports for multiple PVC plastic piping shall be continuous wherever possible.
 2. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays.
 3. Ladder shall be of galvanized steel construction.
 4. Rung spacing shall be 12 inches.
 5. Tray width shall be approximately 6 inches for single runs and 12 inches for double runs.
 6. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc., required by a complete support system.
 7. Acceptable manufacturers:
 - a. Electray Ladder by Husky-Burndy;
 - b. Globetray by the Metal Products, a division of United States Gypsum,
 - c. Or equal.
 8. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners similar to Globe, Model M-CAC; Husky-Burndy, Model SCR or equal.
 9. Spacing between clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe. Individual clamps, hangers and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

- E. All vertical pipes shall be supported at each floor or at intervals of not more than 12 feet (whichever is less) by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to insure rigid construction. All vertical pipes passing through pipe sleeves shall be secured using a pipe collar.
- F. Link-seal compression type wall penetration sleeves shall not be used to support static or dynamic loads. Additional supports shall be provided such that static gravity loads and horizontal dynamic loads are not transferred to these penetration sleeves.

2.2 MATERIALS

- A. Unless otherwise specified herein, pipe hangers and supports shall be standard catalogued components, conforming to the requirements of MSS-SP-58, MSS SP-69 and MSS SP-89.
- B. Pipe hangers, supports, braces and accessories shall be standard catalogued components as manufactured by Anvil International, Inc, Carpenter & Peterson, Inc. or equivalent (metallic pipe) or Jove (non-metallic pipe). Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary.
- C. Materials of all prefabricated pipe hangers, supports, braces and accessories (including bolts, nuts, washers) shall be as follows:
 - 1. For steel, stainless steel, ductile iron, HDPE, FRP and PVC piping:
 - a. Exposed interior or exterior and all other spaces not otherwise defined below shall be hot-dipped galvanized steel conforming to ASTM A123 and ASTM A152.
 - b. Submerged or within/directly above tanks shall be Type 316 stainless steel.
 - c. Exposed interior spaces subjected to a damp or corrosive environment including the following spaces shall be Type 316 stainless steel.
 - i. Headworks Room
 - ii. Wetwell
 - 2. For copper piping: shall be copper plated steel.
- D. Type 1
 - 1. Metallic pipe (Steel, stainless steel and ductile iron):
 - a. Adjustable Clevis Type (Type S) (Pipes greater than 4" diameter):
 - i. Anvil International, Inc. (Fig 260)
 - ii. Carpenter & Patterson Inc. (Fig 100)
 - iii. Or equal
 - b. Adjustable Clevis Type (Type S) (Pipes 4" diameter or less):
 - i. Anvil International, Inc. (Fig 65)
 - ii. Carpenter & Patterson Inc. (Fig 200)
 - iii. Or equal
 - c. Adjustable Steel Yoke Pipe Roll (Type S):
 - i. Anvil International, Inc. (Fig 181)
 - ii. Carpenter & Patterson Inc. (Fig 140)
 - iii. Or equal
 - d. Adjustable Pipe Roll (Type S):
 - i. Anvil International, Inc. (Fig 177)

- ii. Carpenter & Patterson Inc. (Fig 142)
 - iii. Or equal
 - e. Pipe Clamp (Type F):
 - i. Anvil International, Inc. (Fig 212, Fig 216 or Fig 295 Clamp w/ Fig 272 Eyerod)
 - ii. Carpenter & Patterson Inc. (Fig 175, Fig 298 or Fig 304 Clamp w/ Fig 93 Eyerod)
 - iii. Or equal
 - f. U-Bolt (Type S)
 - i. Anvil International, Inc. (Fig 137)
 - ii. Carpenter & Patterson Inc. (Fig 283)
 - iii. Or equal
 - 2. Non-Metallic pipe (HDPE, FRP and PVC):
 - a. Adjustable Clevis Type (Type S):
 - i. Jove (Model FS-11)
 - ii. Or equal
 - b. Pipe Clamp (Type F):
 - i. Jove (Model FS-4)
 - ii. Or equal
 - 3. Copper Pipe:
 - a. Adjustable Clevis Type (Type S)
 - i. Anvil International, Inc. (Fig CT-65)
 - ii. Carpenter & Patterson Inc. (Fig 100CT)
 - iii. Or equal
 - b. Adjustable Swivel Ring Type (Type S)
 - i. Anvil International, Inc. (Fig CT-69)
 - ii. Carpenter & Patterson Inc. (Fig 1ACT)
 - iii. Or equal
- E. Type 2
- 1. Metallic pipe (Steel, stainless steel and ductile iron):
 - a. Pipe Roll Stand (Type S) (Non Adjustable)
 - i. Anvil International, Inc. (Fig 271)
 - ii. Carpenter & Patterson Inc. (Fig 39)
 - iii. Or equal
 - b. Pipe Roll Stand (Type S) (Adjustable)
 - i. Anvil International, Inc. (Fig 274)
 - ii. Carpenter & Patterson Inc. (Fig 40)
 - iii. Or equal
 - c. Pipe Roll Chair (Type S)
 - i. Anvil International, Inc. (Fig 175)
 - ii. Carpenter & Patterson Inc. (Fig 67)
 - iii. Or equal
 - d. Adjustable Pipe Roll (Type S)
 - i. Anvil International, Inc. (Fig 177)
 - ii. Carpenter & Patterson Inc. (Fig 109)
 - iii. Or equal

PREFABRICATED PIPE HANGERS, SUPPORTS AND BRACING

- e. Pipe Alignment Guide (Type G)
 - i. Anvil International, Inc. (Fig 255 or 256)
 - ii. Carpenter & Patterson Inc. (Fig 1006 or 1007)
 - iii. Or equal
- f. Pipe Slide Assembly (welded to pipe) (Type G or F)
 - i. Anvil International, Inc. (Fig 257 or 436)
 - ii. Carpenter & Patterson Inc. (Fig 1010)
 - iii. Or equal
- g. Pipe Slide Assembly (w/ welded clamp) (Type G or F)
 - i. Anvil International, Inc. (Fig 257 or 436 w/ Fig 432 clamp)
 - ii. Carpenter & Patterson Inc. (Fig 1010 w/ Fig 158 clamp)
 - iii. Or equal
- h. Floor Mounted Stanchions w/ Adjustable Saddles (Type S)
 - i. Anvil International, Inc. (Fig 63 Stanchion w/ Fig 264 or Fig 265 Saddle)
 - ii. Carpenter & Patterson Inc. (Fig 138 Stanchion w/ Fig 101 or Fig 101U Saddle)
 - iii. Or equal
- i. Concrete cradles
 - i. Provide as detailed on the Structural Drawings
- 2. Non-Metallic pipe (HDPE, FRP and PVC):
 - a. Pipe Slide Assembly (w/ welded clamp) (Type G or F)
 - i. Jove (Model FS-8)
 - ii. Or equal
 - b. Floor Mounted Stanchions w/ Adjustable Saddles (Type S)
 - i. Jove (Model FS-7 with stanchion)
 - ii. Or equal
 - c. Concrete cradles
 - i. Provide as detailed on the Structural Drawings
- F. Type 3 (Type S) (all pipes)
 - 1. Wall Bracket
 - a. Anvil International, Inc. (Fig 194, Fig 195 or Fig 199)
 - b. Carpenter & Patterson Inc. (Fig 69, Fig 84 or Fig 139)
 - c. Or equal
 - d. Fabricated brackets may be used in lieu of pre-fabricated brackets. Material shall conform to Part C above.
- G. Accessories:
 - 1. Threaded Rods
 - i. Anvil International, Inc. (Fig 140, 142 or 146)
 - ii. Carpenter & Patterson Inc. (Fig 94 or 133)
 - iii. Or equal
 - 2. Pipe Insulation Shield
 - i. Anvil International, Inc. (Fig 167 or Fig 168)
 - ii. Carpenter & Patterson Inc. (Fig 265GS or Fig 265P)
 - iii. Or equal

3. Pipe Insulation Saddle
 - i. Anvil International, Inc. (Figs 160-166A)
 - ii. Carpenter & Patterson Inc. (Figs 351-357Z)
 - iii. Or equal
4. Anti-seize compound
 - i. Never Seez by Bostik, Inc.
 - ii. Or equal
- H. Miscellaneous Pipe Hangers, Supports and Braces (Type 4 or Custom):
 1. Contractor shall provide additional hangers, supports and braces as required that are not classified as Types 1, 2 or 3 above.
 2. Materials shall conform to Part C above.
- I. Concrete Anchorage:
 1. Epoxy anchors. ASTM C881, non-expanding, two-component epoxy resin with AISC Type 316 Stainless Steel threaded rod with washer nut. Manufactured by Hilti Fastening Systems (HIT RE500SD); Ramset Fastening Systems (Chemset Capsule Series); Power Fasteners (T308 Plus); or equivalent.
 2. Expansion anchors. Stainless steel AISI Type 316 for galvanized and aluminum fabrications; cadmium plated for painted steel fabrications. Manufactured by Hilti Fastening Systems (Kwik Bolt III); Ramset Fastening Systems (Tru Bolt Stud Anchor); Power Fasteners (Power Stud); or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install prefabricated hangers and supports in accordance with the pipe support shop drawings, in accordance with MSS SP-89 and as specified herein. Deviations from the shop drawings shall not be permitted without written approval from the Pipe Support Design Engineer.
- B. Hangers shall be used for their intended purpose only. They shall not be used for rigging or erection purposes.
- C. General Contractor shall coordinate the installation of field run conduit, piping and other utilities to avoid interference with the pipe supports.
- D. All pipe supports shall include features to permit adjustments of pipe elevations. Once all piping is properly aligned and at the correct elevations, the supports shall be locked into place. Locking nuts, cotter pins, temporary locking devices and other locking means should be properly engaged. Tack welding shall not be utilized to lock supports in place.
- E. Type 1 hangers using threaded rods shall be attached to the building structure or supplemental framing. Connections to the building structure shall be with beam clamps, welded angles or embedded concrete weld plates or threaded inserts.
- F. Install all drilled anchors in accordance with the anchor Manufacturer's instructions.
- G. Secure Type 2 pipe support to structural supporting member. All pipe supports shall be rigidly anchored to their structural supporting members.
- H. PVC Piping and Fiberglass Piping: Support in strict accordance with the manufacturer's instructions and recommendations for the conditions of operation, temperature and size of pipe. Support in a manner which will prevent subsequent

visible sagging of the pipe between supports due to plastic deformation.

- I. All surfaces of steel and aluminum in contact with or embedded in concrete or masonry shall be coated with epoxy paint (min 5 mils dry film thickness).
- J. Drain, waste, and vent piping: Support by adjustable hangers.
- K. Valves, Fittings & Specialties: Independently support pipe connected to pumps, equipment and piping systems.
- L. Temporary pipe supports:
 - 1. General Contractor shall be responsible for providing all temporary pipe supports and rigging.
 - 2. Lay out each section of pipeline and make connections while the pipe is held in temporary supports.
 - 3. After the completion of connections in each section of pipeline, hold the section in place with temporary clamps.
 - 4. Do not remove the temporary clamps until the piping is correctly installed on the permanent supports.

3.2 TESTING

- A. All permanent pipe supports shall be installed prior to testing.
- B. Demonstrate compliance with the requirements of this section with respect to support, pitch, vibration, movement, and expansion and contraction during start-up testing of the equipment and associated piping systems as indicated in Section 01800.
- C. Systems which do not meet the requirements of this section with respect to support, pitch, vibration, lateral movement, and expansion and contraction shall be supplemented with additional braces as required and re-demonstrated until compliance is achieved.

3.3 COATINGS

- A. Provide shop coatings in accordance with Section 09905.
- B. Provide field coatings for steel items in accordance with Section 09900.
- C. Provide touch-up field galvanizing for hot dipped galvanized items in accordance with Section 09900.
- D. Provide field coatings on surfaces with dissimilar metals. Utilize epoxy paint (minimum 5 mil thickness) in accordance with Section 09900.
- E. Provide temporary support or bracing as necessary to allow complete and continuous coats.

CERTIFICATE OF DESIGN

RE: Contract between
OWNER: _____

CONTRACTOR: _____

PROJECT: _____

The undersigned hereby certifies that the engineer listed below:

1. Is licensed or registered to perform professional engineering work in the State of _____; (Location of Project)
2. Is qualified by education and training to design the pipe support and bracing system as specified in Section 15094 of subject contract;
3. Has previously designed comparable pipe support and bracing systems;
4. Has prepared the design in full compliance with the requirements of subject contract documents, including all applicable laws, regulations, rules, and codes; and
5. Has confirmed by design that the static gravity loads and dynamic horizontal and vertical seismic, hydraulic pressure, and thrust forces tributary to each pipe support and the system as a whole have been determined, and that all supports and braces are designed to resist these forces within the allowable capacities of each component of the pipe support, including anchorage. (Excluding supports specifically designed by the Engineer-of-Record Wright-Pierce)
6. Will inspect the completed installation of the pipe support system to confirm that the system is installed and functions in accordance with the design.

CONTRACTOR

PIPE SUPPORT DESIGN ENGINEER

By: _____
(Signature)

By: _____
(Signature)

(Name)

(Name)

(Title)

(Professional Engineer No. and State)

(Date)

(Date)

END OF SECTION

SECTION 15100

VALVES & SPECIALTIES – GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish, install, support, and test valves, gates, hydrants, cocks, stops, and faucets, when applicable, (hereinafter referred to as "valves") in the location(s) and of the size(s) and quantities shown on the Drawings and/or as specified herein.
- B. Related Work Specified Elsewhere (When Applicable):
 - 1. Surface preparation and shop coatings are specified in Section 09905.
 - 2. Field painting is specified in Division 9.
 - 3. Pipe, fittings, pipe hangers and supports, and piping insulation are specified in the appropriate Sections in this Division.
 - 4. Valves for plumbing, heating and air conditioning are specified in the appropriate Sections in this Division.
 - 5. Instrumentation and Controls are specified in Division 13.
 - 6. Electrical is specified in Division 16.

1.2 QUALITY ASSURANCE

- A. Provide valves of proven reliability manufactured by reputable manufacturers.
- B. Acceptable manufacturers are listed in each section of this Division. Substitute or "or-equal" valves will be allowed only when indicated.

1.3 SUBMITTALS

- A. Provide shop drawings in accordance with the requirements of the General Conditions, Section 01340 and as specified herein. Shop drawings shall contain the following information at a minimum:
 - 1. Completed Submittal Certification Form. Shop drawing submittals will be returned unreviewed without this form.
 - 2. Certified shop drawings.
 - 3. Manufacturer's literature and illustrations for all equipment to be installed to supplement certified shop drawing information.
 - 4. Short-term and long-term storage requirements.
 - 5. Seismic analysis, design and calculations as specified herein.
 - 6. Shop preparation and shop coatings.
 - 7. Proposed valve identification tag information
- B. Provide Operation and Maintenance Manuals in accordance with the requirements of Section 01340.

1.4 DELIVERY AND HANDLING

- A. Shipping:
 - 1. Prepare valves and accessories for shipment as required for complete protection.

2. Seal valve ends to prevent entry of foreign matter into valve body.
 3. Box, crate, completely enclose, and protect valves and accessories from accumulations of foreign matter.
- B. Storage:
1. Store valves and accessories in an area on the construction site protected from weather, moisture, or possible damage.
 2. Do not store valves or accessories directly on the ground.
- C. Handling: Handle valves and accessories to prevent damage of any nature to the interior and the exterior surfaces.

1.5 INSPECTION

- A. Carefully inspect all materials for:
1. Defects in workmanship and materials.
 2. Removal of debris and foreign material in valve openings and seats.
 3. Proper functioning of all operating mechanisms.
 4. Tightness of all nuts and bolts.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials are specified in appropriate Sections in this Division.
- B. The specifications direct attention to certain required features of the valves and gates but do not purport to cover all details entering into their design and construction. Nevertheless, the Contractor shall furnish the valves and gates complete in all details and ready for operation for the intended purpose.

2.2 SURFACE PREPARATION AND SHOP COATINGS

- A. Provide surface preparation and shop coatings in accordance with the applicable section of Division 9.

2.3 VALVE LOCK-OUT/ TAG-OUT HARDWARE

- A. Provide accessory hardware for the purpose of locking out valves utilizing standard padlock. Lockout hardware shall be provided where indicated on the Drawings or specified elsewhere.

2.4 VALVE ACTUATORS

- A. Unless otherwise specified or shown on the Drawings, all valves shall be manually actuated. All valves shall have an operating handwheel or a handle/lever mounted on the operator. Valves with operating nuts shall be of non-rising stem design and be provided with an AWWA 2 inch square operating nut. The valves shall be provided with handwheel actuators on all manually actuated valves larger than 6 inches in size unless otherwise specified or shown on the Drawings.
- B. The valve Manufacturer shall supply and factory mount all actuators; including any type of manual or powered actuators. The valves and actuators shall be shipped as a single unit. All valve actuators shall be sized to operate the associated valve for the full range of pressures and velocities. Position indicators shall be provided for interior NRS valves.

- C. The force in a manual actuator shall not exceed 40 pounds of rim-pull under any operating condition, including initial breakaway. The actuator shall be equipped with gear reduction when force exceeds 40 pounds of rim-pull. All manual actuators shall be self-locking type or shall be equipped with a self-locking device. The actuators shall be capable of moving the valves from a fully open to a fully closed position and a fully closed position to a fully open position. The actuator shall be capable of holding the valve at any position in between the fully open and fully closed positions. A position indicator shall be supplied on quarter-turn valves. Each actuating device shall have the word "OPEN" permanently cast as well as an arrow indicating the direction of operation.
- D. Unless otherwise specified or shown on the Drawings chainwheel actuators shall be provided for all valves 3 inches and larger; with the valve center line located 6 feet or greater above the operating floor. All chainwheel actuators shall be provided complete with chain guides and hot dipped galvanized or cadmium-plated steel chain. The chain shall loop within a minimum of four (4) feet from the operating floor level. Where chains hang in normally traveled areas, appropriate "L" type tie-back anchors shall be used.
- E. All chainwheel actuators of the same type, style, and duty shall be supplied by a single Manufacturer. Where applicable and whenever possible, chainwheel actuators shall be provided by the Manufacturer of the valve being served.

2.5 GEAR ACTUATORS

- A. Unless otherwise specified or shown on the Drawings, all valves larger than 6 inches shall be provided with gear actuators. All manually actuated valves with a rim pull greater than 40 ft-lbs shall also be provided with gear actuators. Worm and gear actuators shall be a one-piece design with worm-gears of gear bronze or machine cut steel material. Worm shall be hardened alloy steel with the thread ground and polished. Traveling nut type actuators shall have threaded steel reach rods with an internally threaded bronze or ductile iron nut.
- B. The output shaft shall be perpendicular to the valve shaft and be provided with a removable handwheel. Unless otherwise noted or specified all gear actuators shall conform to AWWA C504 standards. All gear actuators shall be removable from the valve without removing the valve from the line or dismantling the valve.
- C. All gear actuators shall indicate the valve position and have adjustable stops. The maximum handwheel size shall be 24 inches in diameter. All position indicators shall be of the embossed, stamped, engraved, etched, or raised types.
- D. Unless otherwise specified or shown on the Drawings, all gear actuated valves 3 inches and larger shall be provided with position indication at the point of operation. Valves smaller than 3 inches shall have position indication on their respective handwheels or lever actuators.

2.6 FLOOR STANDS

- A. Provide floor stands where required on the Drawings.
- B. Floor stands shall be of the non-rising stem, indicating type, and designed for counterclockwise operation. The distance from the base flange to the handwheel shall not be less than 34".
- C. The pedestal shall be cast of ductile iron grade 65-45-12 and meet ASTM-A536.

The pedestal shall have a vertical indicating slot. The word “OPEN” shall be cast in the pedestal at the top of the indicating slot. A “CLOSED” tag will be field mounted to the pedestal, to indicate the closed position of the valve. A bronze indicator shall travel on a carbon steel threaded stem to indicate the position of the valve.

- D. The stem shall be Xylan coated to prevent corrosion.
- E. The floor stand shall be coated in a two-part epoxy for corrosion resistance.
- F. Where a floor is not directly over the valve and extension stem, the floor stands shall be supported by a ductile iron wall bracket mounted to the side wall. Wall brackets shall contain a carbon steel plate designed to support the floor stand.
- G. Stem guides with corrosion resistant bushing shall be provided as recommended by the floor stand manufacturer.
- H. The floorstand shall be operated by a cast iron handwheel of no less than 12” in diameter.
- I. Floorstands shall be as manufactured by:
 - 1. Trumbull Industries, Youngstown, Ohio.
 - 2. Troy Valve, Troy, Pennsylvania.
 - 3. Or Equivalent

2.7 VALVE IDENTIFICATION TAGS

- A. All valves in piping including individual valves provided with equipment shall be tagged in accordance with that shown on the Drawings. The tags shall be provided with identifying numbers and letters to match those shown on the Drawings. Identification tag numbering shall be reviewed/confirmed with the Engineer and Owner through the submittal process prior to ordering any tags. Refer to Section 11000 for additional information regarding valve tagging.
- B. All identification tags shall be provided with sufficient lengths of chain for attachment to the respective valve.
- C. Tags shall conform to the following specifications:
 - 1. The tags shall be 2.5-inch diameter, 1/16" thick, rigid, multi-layered sandwich laminate with contrasting inner and outer colored acrylic plastic layers. Top hole size is 5/32" for hanging tags.
 - 2. Tags shall be available in 7 different outside colors. Owner and Engineer shall select up to 4 different colors for the project.
 - 3. Tags shall have up to three lines engraved on a side and eight characters per line of identification information. Tags shall be engraved one side.
 - 4. Tags shall be secured to valves with nylon cable ties or adjustable metal bead chain. Securing method shall be selected by the Owner and Engineer.
 - 5. Tags secured to equipment shall be fastened to a flat visible surface by a minimum of two SS screws or SS pop rivets.
 - 6. Tags shall have a service temperature of -40°F to 175°F
 - 7. Manufactured by Seton Name Plate Corporation, New Haven, CT, Brimar Industries, Garfield, NJ or equal.
- D. All buried valves shall be provided with tags embedded in a concrete pad surrounding the valve box.

PART 3 - EXECUTION

A. INSTALLATION

- B. Install valves and accessories in strict accordance with manufacturer's instructions and recommendations, as shown on the Drawings and/or as specified herein. Install valves with stems pointed up in vertical position, or horizontally on high valve for chain wheel use, but in no case with stems pointed downward of the horizontal plane. Allow sufficient room for maintenance, removal and proper operation. All valves shall be located and oriented to permit easy access to the valve operator, and to avoid interferences.
- C. Valve Orientation: The stem of a manual valve shall be installed in a vertical position when the valve is installed in horizontal runs of pipe having centerline elevations of 4.5 feet or less above finished floor, unless otherwise shown on Contract Drawings. The stem of a manual valve shall be installed in a horizontal position in horizontal runs of pipe having centerline elevations between 4.5 feet and 6 feet above the finish floor, unless otherwise shown on Contract Drawings. All manually actuated valves 3 inches and smaller shall have the valve indicators and operators located to display toward the normal operational locations.
- D. Carefully erect all valves and support them in their respective positions free from distortion and strain.
- E. Independently support all valves connected to pumps and equipment, and in piping systems that cannot support valves.
- F. Repair any scratches, marks and other types of surface damage etc. with original coating as supplied by the factory.
- G. Install valves such that "open" and "close" position indicators are easily visible.
- H. All valves (and actuators where specified) shall be installed in a manner that will provide for proper clearances and ease of operation. In addition, valve actuators must be capable of being rotated in 90° increments to facilitate field installation.
- I. Check and adjust all valves and accessories for smooth operation.

3.2 TESTING

- A. The Contractor shall test all valves and gates in the presence of the Engineer to demonstrate that each valve and gate complies with specified requirements and allowable leakage rates.
- B. The contractor shall test all valves visually for leaks and proper operation under pressure. The contractor shall also test the valves to ensure proper valve function and actuation.
- C. Valves may either be tested while testing pipelines, or as a separate step. It shall be demonstrated that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, and in both directions for two-way valve applications. The Contractor shall count and record the number of turns required to open and close each valve and account for any discrepancies with the Manufacturer's data.
- D. Air and vacuum relief valves shall be examined as the associated pipe is being filled to verify venting and seating is fully functional. The Contractor shall set, verify, and record set pressures for all relief and regulating valves. Self-contained automatic valves shall be tested at both maximum and minimum operating ranges and reset upon completion of test to the design value.

- E. The contractor shall take care not to overpressure any valve and appurtenances during testing.

3.3 RETESTING

- A. If the equipment does not successfully pass the tests listed above, the Manufacturer/Contractor shall repair the equipment and perform the tests again until passing the tests successfully. If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be re-conducted at no additional cost to the Owner.

3.4 CLEANING

- A. All items, including but not limited to all valves and valve interiors, shall be thoroughly cleaned prior to installation, testing, and final acceptance. All dirt, debris, and other foreign materials shall be removed.

3.5 FIELD COATINGS

- A. In accordance with Section 09900.

END OF SECTION

SECTION 15101

GATE VALVES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish, install and test gate valves of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified.
- B. Related Work Specified Elsewhere: "Valves and Specialties - General" is specified in this Division.

1.2 QUALITY ASSURANCE

- A. All gate valves of same type and style shall be manufactured by one manufacturer.
- B. Acceptable Manufacturers: as noted herein.

PART 2 - - PRODUCTS

2.1 VALVE, LOCATION AND USE

- A. As shown on the Drawings.
- B. Water Supply Piping:
 - 1. Buried: AWWA Type, NRS.
 - 2. Exposed: AWWA OS&Y, or NRS as required.
- C. General Service Piping (liquids containing solids):
 - 1. Includes plant water, and liquids containing solids.
 - 2. 2-1/2 inches and smaller: 125 bronze.
 - 3. 3 inches and larger: Non-rising stem; resilient wedge.
- D. Accessories: As shown on the Drawings and required for proper operation.

2.2 MATERIALS

- A. Waterworks type NRS valves (AWWA):
 - 1. Valve Body, bonnet and stuffing box - Cast iron (ASTM A126, C1B), or Ductile iron (ASTM A536), coated inside and out with fusion bonded epoxy meeting AWWA C550. Face-to-face dimensions shall comply with ANSI B16.10 and flanges to comply with ANSI B16.1.
 - 2. Resilient Wedge - Ductile iron wedge with bonded EPDM or Nitrile (Buna-N/NBR) rubber covering.
 - 3. Stem - Manganese bronze, ASTM B584
 - 4. Stuffing box O-rings
 - a. Two O-rings, each nitrile rubber.
 - b. Capable of changing under pressure.
 - 5. Wedgenut - Bronze, ASTM B62 or Manganese bronze, ASTM B584
 - 6. Bolting - stainless steel Type 18-8 (304 SS), ASTM F593, GP1
 - 7. Water working pressure: 250 psi
 - 8. End Connections
 - a. Buried valves – gasketed and bolted mechanical joints in conformance with AWWA standards for appropriate pipe material.

- b. Exposed valves – flanged and bolted joints in conformance with ANSI/ASME B16.1 and AWWA standards for appropriate pipe material. Bolts shall be stainless steel.
 - 9. Operation
 - a. Buried valves – 2-inch square nut, cast iron, ASTM A126, C1B or ductile iron, ASTM A536
 - b. Exposed valves - Handwheel, cast iron or cast aluminum with direction arrow.
 - c. Chain wheel:
 - i. Required for all valves where shown, when required for proper operation and for all valves with centerline 7 feet above finished floor or equipment stand. Provide chain guides. Chain shall extend to 3 feet above floor. Provide wall hooks for chain.
 - d. Opening Direction – counterclockwise (open left)
 - 10. Standards - valves shall meet or exceed AWWA C509, latest edition.
 - 11. Manufacturer
 - a. American Flow Control
 - b. Kennedy/McWane
 - c. Clow/McWane
 - d. Mueller
 - e. Or equal
- B. Waterworks type OS&Y valves (AWWA):
 - 1. Equal in all respects to non-rising stem valve specified above, except as required for OS&Y operation.
- C. General Service - 2-1/2 inch and smaller:
 - 1. Bronze construction - 125 pound stem.
 - 2. Union bonnet.
 - 3. Inside screw, rising stem.
 - 4. Solid disc, taper wedge.
 - 5. End connections:
 - a. Threaded.
 - b. Or solder ends for copper pipe systems.
 - 6. 200 psi non-shock WOG.
 - 7. Malleable iron, or steel handwheel.
 - 8. Acceptable Manufacturers:
 - a. Stockham B-105.
 - b. Craine 428-UB.
 - c. Powell 2700S.
 - d. Jenkins 47U.
 - e. Kennedy/McWane 525.
 - f. Or approved equal.
- D. General Service NRS - 3 inches and larger:
 - 1. Wedge shall be constructed of ductile iron, fully encapsulated in synthetic rubber, except for guide and wedge nut areas.
 - 2. Non-rising stem (NRS).
 - 3. Bolted bonnet (stainless steel Type 18-8, ASTM F593, GP1 bolts and nuts).

4. 125 class body.
5. Meet or exceed AWWA C-509.
6. All valves shall be fitted with a resilient wedge.
7. Flanged ends: 125 pound drilling, ANSI B16.1.
8. Face to Face dimensions: ANSI B16.1.
9. Water working pressure:
 - a. 12 inches and smaller: 200 psi.
 - b. 14 inches and larger: 150 psi.
10. End Connections
 - a. Buried valves – gasketed and bolted mechanical joints in conformance with AWWA standards for appropriate pipe material.
 - b. Exposed valves – flanged and bolted joints in conformance with ANSI/ASME B16.1 and AWWA standards for appropriate pipe material. Bolts shall be stainless steel.
11. Operation:
 - a. Buried valves – 2-inch square nut, cast iron, ASTM A126, C1B or ductile iron, ASTM A536
 - b. Exposed valves - Handwheel, cast iron or cast aluminum with direction arrow; except when 2 inch square operating nut when shaft extension, floor box, valve box or floor stand is required or shown on the Drawings.
 - c. Chain wheel:
 - i. Required for all valves where shown, when required for proper operation and for all valves with centerline 7 feet above finished floor or equipment stand. Provide chain guides. Chain shall extend to 3 feet above floor. Provide wall hooks for chain.
 - d. Floor Stand (Wetwell Isolation Valves):
 - i. Provide ductile iron floor stand with position indicators (dial-type indicators are not acceptable) where shown on the Drawings. Floor stand shall be epoxy coated at the factory. Provide intermediate shaft supports as recommended by the Manufacturer based on shaft length.
 - e. Opening Direction – counterclockwise (open left)
12. Buried Valves:
 - a. All mechanical joint gate valves shall meet ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.
 - b. Mechanical joint type coated inside and out with fusion bonded epoxy meeting AWWA C550.
 - c. 2-inch square operating nut, securely fastened to shaft.
 - d. Gate box required.
 - e. Sufficient quantity of tee-handle valve wrenches for operating valves of various depths.
 - f. Opening Direction – counterclockwise (open left)

13. Acceptable Manufacturers:
 - a. American Flow Control
 - b. Kennedy/McWane
 - c. Clow/McWane
 - d. Mueller
 - e. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and test in accordance with Section 15100, AWWA C500 and AWWA C-509, latest revision.
- B. For horizontal piping, install valves with stem position between horizontal to vertical upward.

END OF SECTION

SECTION 15110

CHECK VALVES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish and install check valves of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified herein.
- B. Related Work Specified Elsewhere: "Valves & Specialties - General" is specified in this Division.

1.2 QUALITY ASSURANCE

- A. All check valves of same type and duty shall be by one manufacturer.
- B. Meet the material requirements of AWWA C508.
- C. Acceptable Manufacturers:
 - 1. Val-Matic SurgeBuster®

1.3 WARRANTY

- A. Warranty shall be provided stating that the valves shall out perform any manufacturers normal equipped air cushioned weight and lever AWWA swing check valve with respect to surge and pressure normally generated by check valve closure fort installation within the manufacturer's published ratings of the valve with regards to pressure, temperature and installation orientation for a period of 12-months from acceptance.

PART 2 - PRODUCTS

2.1 SWING CHECK VALVES - 2-½ INCHES AND SMALLER – GENERAL USE

- A. Standard, all brass or bronze, swing check with screwed ends.
- B. Suitable for 150 psi working steam pressure.
- C. Shall meet MSS SP-80 standards, Class 125, cast-bronze body and cap conforming to B62.
- D. Acceptable Manufacturers:
 - 1. Watts
 - 2. Apollo
 - 3. Or equal.

2.1 SWING TYPE CHECK VALVES – 3 INCH AND LARGER – GENERAL USE

- A. The valve body and cover shall be constructed of ASTM A536 Grade 65-45-12 ductile iron. Dimensions to comply with ANSI B16.1, Class 125.
- B. The disc shall be precision molded Buna-N (NBR), ASTM D2000-BG.
- C. Flanged ends faced and drilled to the 125 lb. Standard.
- D. The working water pressure shall be 175 psig up through 12-inch, inclusive and 150 psig for 16-24 inch, inclusive of the following:

1. This specification is intended to cover the design, manufacture and testing of 3-inch through 42-inch Surgebuster® Swing Check Valves suitable for cold working pressures of 250-psig in water, wastewater, abrasive and slurry service.
- E. The disc accelerator shall be type 302 stainless steel.
- F. The body shall be full flow equal to nominal pipe diameter at all points through the valve. The seating surface shall be on a 45-degree angle to minimize disc travel. A threaded port with pipe plug shall be provided on the bottom of the valve to allow for field installation of a backflow actuator, air cushion or hydraulic cushion without the need for special tools or the need to remove the valve from service to install.
- G. The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be domed in shape to provide flushing action over the disc for operation in line containing high solids content. A threaded port with pipe plug shall be provided in the access cover to allow for field installation of a mechanical disc position indicator.
- H. The disc accelerator shall be of one piece construction and provide rapid closure of the valve in high head applications. The disc accelerator shall be enclosed in the valve and shall be field adjustable and replaceable without removal of the valve from the pipeline. The disc accelerator shall be securely held in place by being captured between the cover and the disc. It shall be formed with a large radius to allow smooth movement over the disc surface.

2.2 OPTIONAL ACCESSORIES

- A. Provide a mechanical indicator for each valve to provide disc position indication. The indicator shall have continuous contact with the disc under all operating conditions to assure accurate disc position indication.
- B. Provide a pre-wired limit switch for each valve to indicate open/closed position to a remote location. The mechanical type limit switch shall be activated by the external position indicator. The switch shall be rated for NEMA 4, 6, or 6P and shall have U.L. rated 5 amp, 125 or 250 VAC contacts. Equal to Square D Model 9007C52J or equivalent. Coordinate the provide limit switches with the electrical subcontractor and systems integrator on the project.
- C. Provide a bottom mounted oil dashpot if required. Manufacturer shall review design conditions and determine if additional hydraulic control of valve closure is required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. In accordance with Section 15100.
- B. Install check valves in horizontal sections of pipeline unless otherwise indicated on the Drawings.

END OF SECTION

SECTION 15180

PIPE AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Provide insulation to all non-buried interior piping and equipment as scheduled herein, including but not limited to domestic water, process water, and heating system pipeline components.
- B. Provide insulation jacketing as scheduled herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

- A. Requirements Specified Elsewhere: Additional requirements are specified elsewhere including, but not limited to General Conditions, Supplementary Conditions, and Division 1.
 - 1. Section 15050 – Piping – General
 - 2. Section 15100 – Valves – General
 - 3. Section 15400 – Plumbing – General
 - 4. Section 15600 – HVAC – General

1.3 QUALITY ASSURANCE

- A. Standards:
 - 1. Fiberglass pipe insulation: ASTM C547, ASTM C1136.
 - 2. All-service vapor retarder jacket: ASTM C1136.
 - 3. Mineral fiber high temperature pipe insulation: ASTM C547, Type II.
 - 4. Flexible elastomeric pipe insulation: ASTM C534
 - 5. PVC jacketing: ASTM D1784, Type 1
 - 6. Aluminum jacketing: ASTM B209, ASTM C1729
 - 7. Dimensional requirements: ASTM C585
 - 8. Thermal conductivity: ASTM C177, ASTM C518
 - 9. Water vapor transmission: ASTM E96
 - 10. Flame spread & smoke development: ASTM E84, UL 723
- B. Insulation shall be installed by skilled and experienced applicators who are regularly engaged in commercial and industrial insulation work.
- C. Fire Hazard Rating: All insulation materials, adhesives, coatings and other accessories shall have a listed hazard rating not to exceed 25 for flame spread and 50 for smoke developed.

1.4 SUBMITTALS

- A. Submit manufacturer's literature containing material product data in accordance with the General Conditions of the Construction Contract, Section 01340, Section 15050, Section 15100, Section 15400, and Section 15600.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide insulation on pipe and equipment as identified in Table 1 and at the thicknesses identified in Table 2.
- B. Fiberglass Pipe Insulation:
 - 1. Biosoluble glass fibers bonded with thermosetting resin
 - 2. All service vapor retarder jacket.
 - 3. All cold piping shall be sealed with continuous, unbroken vapor seal to prevent condensation.
 - 4. Provide PVC jacketing on straight runs of fiberglass insulated piping as identified in Table 3.
 - 5. Acceptable Manufacturers:
 - a. Owens-Corning
 - b. Johns Manville
 - c. Thomas Insulation
 - d. Or equal
- C. Flexible Preformed Elastomeric Insulation:
 - 1. For use on piping in designated wet areas as identified in Table 3
 - 2. Insulation material shall be manufactured without the use of CFC's, HFC's or HCFC's. Insulation shall be formaldehyde free, low VOC's, fiber free, dust free and mold and mildew resistant.
 - 3. Insulation shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft²- °F at a 75°F mean temperature. Insulation shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision.
 - 4. Methods of Securing:
 - a. Manufacturer's recommended adhesive, applied by brush to both butting insulation surfaces.
 - b. Self-sealing adhesive, factory applied to the seam, plus PVC overlap tape.
 - 5. Insulation jacketing: Field applied jacket.
 - 6. Acceptable Manufacturers:
 - a. AeroFlex USA Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
 - d. Or equal.
- D. Fittings and Valves:
 - 1. Pre-molded PVC covers with fiberglass fill on fiberglass insulation systems.
 - 2. Do not insulate unions and flanges.
- E. Staples: Outward clinching type, Type 304 or 316 stainless steel.
- F. Adhesives:
 - 1. Fiberglass: Non-flammable vapor barrier adhesive as manufactured by Benjamin Foster or Childers or equal.

2.2 INSULATION APPLICATION TABLES

TABLE 1 – PIPING WHICH REQUIRES INSULATION

PIPE SYSTEM	FLUID TEMPERATURE RANGE (°F)
Heating Systems – Hot Water Supply/ Return	120 – 205
Condensate Drain Piping	40 – 55
Non-Potable Water (Process Water)	40 – 100

TABLE 2 - MINIMUM PIPE INSULATION THICKNESS (IECC)

FLUID OPERATING TEMPERATURE RANGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE SIZE (INCHES)				
	Conductivity (BTU-in/hr-ft ² -°F)	Mean Temperature Range (°F)	<1	1 to 1 ½	1 ½ to <4	4 to <8	8+
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.21-0.28	100	1.0	1.0	1.5	1.5	1.5
40-60	0.21-0.27	75	0.5	0.5	1.0	1.0	1.0

TABLE 3 - IDENTIFICATION OF INSULATION TYPES

Locations	Fiberglass	Fiberglass with PVC Jacketing	Flexible Preformed Elastomeric
All areas not listed below	X		
Pump Room		X	
Wet Well			X

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's written instructions, submittals, and in proper relationship with adjacent construction.
- B. Apply insulation only after all pipes have been tested and approved.
- C. Clean and dry all surfaces to which insulation is to be applied.
- D. Insulation at sleeves:
 1. Insulation shall be continuous through all sleeves except where gas-tight seal is indicated.
 2. Provide aluminum cover on insulation where caulking is required.
 3. Delete insulation at walls requiring a gas-tight seal.
- E. Insulation at Hangers:
 1. Insulation shall be continuous at hangers.
 2. Piping shall be supported in such a manner that the insulation is not compromised by the hanger or the effects of the hanger.
 3. Provide protection saddles at pipe hangers where required to prevent compression or distortion of insulation in accordance with insulation manufacturer's requirements.
 4. Piping systems larger than 3 inches in diameter, high-density inserts with sufficient compressive strength to support the piping shall be used between the pipe and support.
 5. Hanger spacing shall be such that the circumferential joint shall be outside the hanger.

6. In vertical applications, insulation support rings shall be used with no more than 8 feet spacing between them or as indicated on drawings. The support ring shall be wide enough to support one half of the thickness of the outermost insulation layer.
- F. Fiberglass or mineral fiber insulation shall be firmly fastened in place with joints (longitudinal and circumferential) butted tightly and mechanically held in place using one 16-gauge stainless steel wire or 0.5 inches x 0.020 inches stainless steel bands and clips, placed on maximum 12-inch centers.
- G. Maintain a vapor barrier by properly sealing joints, penetrations, and other openings.
- H. Seal valve stems with caulking to allow free movement of the stem but still provide a seal against moisture incursion.
- I. Apply equipment insulation as smooth as possible by grooving, scoring, and beveling insulation as necessary.
- J. Bevel and seal the ends of insulation to equipment, flanges, and piping.
- K. Flanges, couplings, and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as the surrounding pipe sections.
- L. Rough cut ends, laps, joints, exposed staples shall be coated with a suitable vapor resistant mastic.
- M. On hot systems where fittings are to be left exposed, insulation ends shall be beveled away from bolts for easy access.
- N. Neatly finish insulation at supports, protrusions, and interruptions.
- O. Do not insulate over nameplates or ASME stamps. Form a tight insulation seal around them.
- P. When equipment with insulation requires periodic opening for maintenance, repair or routine inspection, install the insulation in such a way that it can be easily removed and put back in place without damage.

3.2 CLEANING

- A. Clean all insulation of accumulated paint, concrete, mortar, etc.
- B. Do not damage insulation during cleaning.

END OF SECTION

SECTION 15400

PLUMBING – GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Perform the following items of work required to complete the work of this Section, as shown on the drawings, and specified herein:
 - 1. All labor, materials, equipment, and transportation shall be provided as required to completely furnish, install, and test the plumbing and water systems, with all connections as shown on the drawings and described in these specifications or as required by the Plumbing Code of the Project State. The accompanying drawings do not show every detail of pipe, valves, fittings, hangers, equipment, and fixtures which are necessary for the complete installation but are provided to show the general arrangement and extent of work to be performed. Provide all work as indicated on the drawings together with all items necessary for or incidental to the completion of the work.
- B. Work Included: The plumbing work shall include, but not be limited to the following (when applicable), refer to requirements specified in Division 15:
 - 1. Fuel gas supply systems.
 - 2. Sump pumps and associated piping and controls.
 - 3. Plumbing pipe identification and signage.
 - 4. All other plumbing items indicated on the drawings, specified herein, or needed for a complete and proper plumbing installation.
- C. Drawings and Measurements:
 - 1. The Drawings show the general arrangement, direction, and sizes of pipes. They are not intended to show every offset, valve, and fitting, and every structural difficulty that may be encountered.
 - 2. Coordinate installation of plumbing systems with the work of other trades.
 - 3. Verify all measurements at the job site.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

- A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

- A. Materials and Workmanship: All materials and workmanship shall be suitable for the respective work and the type of service encountered.
- B. Equipment: All equipment shall be constructed to operate safely without water hammer and undue wear.
- C. Local Codes: Install plumbing systems in accordance with applicable state and local plumbing codes, except where requirements of the drawings and these specifications are more stringent.
- D. Permits: Arrange for all permits, inspections, and tests required by codes at no additional cost to the Owner.

E. Standards: When standards are referred to, the latest issue shall apply.

1.4 JOB CONDITIONS

A. Scheduling Work: Install and test all plumbing to be cast into or buried under concrete floor slabs prior to the placement of concrete.

1.5 SUBMITTALS

A. Provide shop drawings in accordance with the requirements of the General Conditions, Section 01340, and as specified herein. Shop drawings shall contain the following information at a minimum:

1. Completed Submittal Certification Form. Shop drawing submittals will be returned unreviewed without this form.
2. Manufacturer's literature and illustrations for all equipment and materials to be installed indicating all capacities, performance requirements, electrical characteristics, options, and accessories as shown on the drawings and as specified in each Section.
3. Guarantees/Warranties as specified in each Section.

B. Submit to the Engineer: Operations and Maintenance Manual for all mechanical equipment as specified in the General Conditions. Refer to Operation and Maintenance section of specification 01340 for all other requirements for submissions to engineer. Operations and Maintenance Manual shall contain the following information at a minimum:

1. Manufacturer's operation & maintenance manuals with all non-applicable content removed or crossed out.
2. Table of Contents
3. Contractor and Manufacturer Contact Information.
4. Operator service requirements including Preventative Maintenance Schedule and Summary.
5. Troubleshooting Information.
6. Warranty Information.
7. Shop Drawings corrected to As-Built Conditions.
8. Wiring and Control Diagrams.
9. Parts and Service Contact Information.
10. List of All Component Part Numbers.
11. Spare Parts and Supply Lists.
12. Completed Operations and Maintenance Manual Certification Form at the start of each section for all equipment provided.
13. Complete the following table for all equipment installed and include following the Table of Contents for all installed equipment or at the beginning of each section for the equipment in that section:

Equipment Name	Unit Tag	Serial Number	Model Number	Building / Location	Date Installed

1.6 DELIVERY, STORAGE & HANDLING

- A. In accordance with Section 01600.
- B. Exercise care during loading, transporting, unloading and handling to prevent damage of any nature to interior and exterior surfaces of equipment, fixtures, pipe and fittings.
- C. Do not drop equipment and fixtures.
- D. Store materials on the project site in enclosures or under protective coverings.
- E. Assure that all materials are kept clean and dry.
- F. Do not store materials directly on the ground.
- G. Exercise care so as not to damage, crack, mar finish and to prevent damage of any nature to fixtures.
- H. Remove damaged fixtures from project and replace at no additional cost to the Owner.
- I. Protect fixtures after installation by wrapping or covering to prevent use and damage.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide materials that are new, suitable for intended use, and of type, style, and quality specified and as shown on the Drawings.
- B. Provide pipe, fittings, and devices that meet requirements of local plumbing codes and be in accordance with applicable ASTM, ANSI, and Commercial Standard (CS) standards.

2.2 BOLTS, ANCHOR BOLTS, NUTS, HANGERS, AND SUPPORTS

- A. Furnish all necessary bolts, anchor bolts, nuts, washers, lock washers or locking nuts, plates and bolt sleeves in accordance herewith. Anchor bolts shall have suitable washers, lock washers and, where so required, their nuts shall be hexagonal.
- B. All bolts, anchor bolts, nuts, washers, lock washers, plates, bolt sleeves, pipe hangers and supports shall be constructed of the following materials:
 - 1. Galvanized steel in accordance with Division 5 unless otherwise indicated below or specified elsewhere.
 - 2. Stainless steel hardware (minimum of Type 304, unless otherwise indicated) is required in all corrosive atmospheres, exterior areas, and/or areas with NEMA 4X or NEMA 7 rating.
 - 3. Stainless steel hardware (minimum of Type 316, unless otherwise indicated) is required in all heavy moisture or submerged applications as well as in wetwells, headworks, dewatering rooms, chemical rooms; and enclosed clarifiers, aeration basins, or storage tanks, etc. For additional description and definition of submerged surfaces refer to Specification Section 09900.

2.3 EQUIPMENT AND VALVE TAGS

- A. Identify all new plumbing equipment shall be identified with a color coded equipment/valve tag. Submit a complete list of proposed Identification Tag information for review by the Engineer and Owner. Tag information shall match the information provided on the Drawings.
- B. Tags shall conform to the following specifications:

1. 2.5-inch diameter, 1/16" thick, rigid, multi-layered sandwich laminate with contrasting inner and outer colored acrylic plastic layers. 5/32" top hole for hanging tags.
2. Tags shall be black or red unless otherwise specified.
3. Tags shall have up to three lines engraved on the outward facing side, with eight characters per line of identification information.
4. Valve tags shall be secured to valves with adjustable stainless steel bead chain.
5. Tags secured to equipment shall be fastened to a flat visible surface by a minimum of two stainless steel screws or stainless steel pop rivets.
6. Tags shall be rated to withstand temperatures from -40°F to 175°F
7. Manufacturers:
 - a. Seton Name Plate Corporation
 - b. Brimar Industries
 - c. Supreme Instrument & Electrical Services
 - d. Equivalent Manufacturer

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install plumbing equipment and piping systems in a neat workmanlike manner.
- B. Lines and Grades:
 1. Unless otherwise shown on the drawings, install piping parallel to building walls wherever possible.
 2. Install piping level or pitched as indicated on the drawings or in accordance with the applicable plumbing code.
- C. Supports: Support piping in accordance with the plumbing code. Hanger and support materials shall be as indicated in Paragraph 2.2.B of this section.
- D. Expansion: Provide provisions for expansion of pipelines.
- E. Do not provide close nipples.
- F. Do not install piping through, directly over, or in front of electrical switchgear and power panels.
- G. Caulk the spaces between the pipe and walls, ceilings, and floors gas-tight where shown on the Drawings.
- H. Fittings for Dismantling Piping: Provide a sufficient number of unions to allow the dismantling of all piping.
- I. Pitch:
 1. Pitch sanitary waste and storm drainage piping in accordance with the plumbing code.
 2. Pitch water piping toward low points. Install hose end drain valves at low points.
- J. Coordinate locations of piping, sleeves, inserts, hangers, equipment, and access provisions with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities.
- K. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- L. Coordinate locations of structural systems necessary for pipe and equipment support

- to permit proper installation.
- M. Coordinate locations of pipe sleeves, trenches and chases with equipment and piping locations.
 - N. Core holes through concrete and masonry using rotary core drill. Locate holes to avoid interference with structural members such as beams or grade beams. Lay out holes in advance and perform drilling only after approval by the Engineer. Obtain approval in advance by the Engineer for drilling holes through structural members.
 - O. Gauges and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms.
 - P. Locate all installations to avoid interference with cranes and materials handling equipment, storage areas, work of other trades, and traffic areas.
 - Q. Perform all work incidental to the installation of the apparatus and materials including, but not limited to, cutting, patching, trenching, excavating, backfilling, trench covering, plastering and the constructing of chases, slots, furring, foundations, piers, and pads, when applicable. All work shall be performed in accordance with the applicable Divisions of this Specification by qualified workers regularly employed in the applicable trades.

3.2 TESTING

- A. When the installation is complete, test pipelines in the presence of the Engineer and the Plumbing or Building Inspector in accordance with the requirements of the local and state plumbing codes. Provide necessary testing equipment and utilities.
- B. Test underground piping prior to backfilling.
- C. Test piping prior to application of paint and insulation.
- D. Separately test portions of piping which will be concealed before completion.
- E. Procedure:
 - 1. Piping Which Carries Water or Liquid Under Pressure: Fill pipes with water and subject them to 100 psig. or 1-1/2 times the normal working pressure, whichever is greater, for two (2) hours with no loss in test pressure.
 - 2. Soil, Vent, Waste and Drain Piping:
 - a. Plug all outlets and fill pipes with water to the top of the highest vent stack above the roof, or with not less than 10 feet of water at all points in section.
 - b. The piping shall maintain this water level for a period of 30 minutes.
 - 3. Fuel Gas Piping: Test with compressed air, in accordance with NFPA 54 requirements prior to backfilling or covering of any pipe. Test pressure shall be 1-1/2 times working pressure or 15 psi (whichever is greater). Test duration shall be not less than 1/2 hour for each 500 cuft of pipe volume. Piping system shall withstand the test pressure without showing any evidence of leakage. Bubble test all fittings and joints with a soap/water solution.
 - 4. Isolate equipment that cannot withstand test pressures prior to any testing.
 - 5. Do not test plastic piping with compressed air or other gases.
- F. Repairs:
 - 1. Should leaks be found, repair as required even to the extent of disassembling and remaking the joints or replacing sections of pipe.
 - 2. Do not repair leaks through the application of external caulking at joint surfaces or the use of chemical compounds.

3. Replace defective pipe and fittings and repeat tests until the testing results are approved by the Engineer.

3.3 PAINING AND IDENTIFICATION

- A. All plumbing piping shall be identified by this Contractor through the use of vinyl pressure sensitive markers. Markers shall indicate system, using abbreviations supplied by Engineer. Each system shall use a different color marker.
- B. Flow arrows shall indicate direction of fluid flow.
- C. Labels and arrows shall be provided at twenty-foot intervals and in or above each room.
- D. Paint plumbing piping, valves, pumps, and equipment in accordance with Specification Section 09900.
- E. Apply signage and identification in accordance with specification section 10140.

END OF SECTION

SECTION 15401

PLUMBING, PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish, install, and test a complete piping system including all required specialties and appurtenances as indicated on the drawings and as herein specified. Refer to additional requirements in specification Section 15400.

1.2 QUALITY ASSURANCE

- A. Standards (General):
 - 1. NSF 61
 - 2. NSF 372
 - 3. ANSI/UL 263
 - 4. ANSI/UL 2846
- B. Standards (Piping):
 - 1. Polyvinyl Chloride (PVC) Pipe: ASTM D1785, ASTM D2665, NSF 14.
 - 2. Copper Tubing (Water Applications): ASTM B88, NSF/ANSI 61 & 372.
 - 3. Crosslinked Polyethylene (PEX) Piping: ASTM F876, ASTM F877, NSF 14.
 - 4. Extruded Polyethylene Gas Piping: ASTM D2513.
 - 5. Steel Pipe: ASTM A53.
- C. Standards (Fittings & Couplings):
 - 1. Polyvinyl Chloride (PVC), Fittings: ASTM D2665, ASTM F1866.
 - 2. Polyvinyl Chloride (PVC), Primer: ASTM F656.
 - 3. Polyvinyl Chloride (PVC), Cement: ASTM D2564.
 - 4. Polypropylene Pipe, Fittings: ASTM F1412, D2657
 - 5. Polypropylene Pipe, Socket end fittings: ASTM F1412, ASTM D2657.
 - 6. Copper Solder fittings: ASTM B16.18, ASTM B16.22.
 - 7. Copper Press fittings: ASME B16.51 and IAPMO PS 117.
 - 8. Crosslinked Polyethylene (PEX) Fittings: ASTM F1960.
 - 9. Extruded Polyethylene Gas Fittings: ASTM D2513.
 - 10. Malleable Iron, Threaded fittings: ASME B16.3.
 - 11. Valves, fuel gas service: ASME B16.33.
 - 12. Forged Steel Fittings: ASTM A105, ASTM A182.

1.3 SUBMITTALS

- A. General: Submittals shall be in accordance with specification Section 01340 and 15400.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe and Fittings:
 - 1. Domestic and Process Water:
 - a. Building Water Service:

- i. Type "L" copper tube with solder or press fittings.
 - ii. When permitted by local codes: Pre-insulated, 160 psi, PEX-a piping with PEX-foam insulation with engineered polymer or lead-free brass cold-expansion fittings.
 - b. Interior Building Lines
 - i. Type "L" copper tube with solder or press fittings.
 - 2. Natural Gas Piping (all materials must meet requirements of NFPA 54 and the Project State adopted fuel gas code as it applies to Natural Gas):
 - a. Buried piping:
 - i. Extruded polyethylene, 150 psi, butt-fusion fittings. Transition fittings: Plastic-to-steel anodeless riser with 7 to 12 mil epoxy coating on exposed metallic surfaces.
 - b. Aboveground piping:
 - i. Less than 1/2 inch: Type "K" soft or hard temper copper tube with AGA approved gas tubing fittings or brazed fittings.
 - ii. 1/2 inch and larger:
 - (1) Piping: Schedule 40 black steel, threaded ends.
 - (2) Fittings: Malleable iron, threaded.
 - (3) Joining method: UL listed graphite joint sealing compound for gas service or tetrafluoroethylene tape, applied to male threads only.
 - (4) Valves: Full port bronze ball, threaded ends, 2-part bronze body, reinforced PTFE or equal resilient seat, blowout-proof stem, lever handle, 600 psi CWP. UL approved for use in fuel gas applications. Apollo 94ALF-A, Nibco T-580-70-UL, Stockham T255, or equivalent product.
 - 3. Other process piping: As indicated on the Drawings.
- B. Solder and Flux:
- 1. Solid string or wire solder, 95 percent tin, 5% antimony on all pressure piping and potable water piping.
 - 2. Silver solder, 45% brazing silver alloy (where indicated).
 - 3. Flux: Non-corrosive paste type as required for type of solder.
 - 4. Solder and flux used on domestic water lines shall be lead free.
- C. Press Fittings for Copper Pipe and Tube:
- 1. Acceptable Manufacturers:
 - a. Viega.
 - b. Mueller.
 - c. Nibco.
 - d. Elkhart.
 - e. Apollo.
 - f. Or approved equal.
 - 2. Shall conform to the material requirements of ASME B16.51.
 - 3. Shall conform to the performance criteria of IAPMO PS 117.
 - 4. EPDM, FKM or HNBR factory installed sealing elements, selected based on manufacturer's approved application guidelines.

5. Fittings shall be installed using the proper tool, jaws, and rings as instructed by the manufacturer.
- D. Valves (Up to and including 2-1/2 inch):
 1. Acceptable Manufacturers:
 - a. Nibco
 - b. Watts
 - c. Apollo
 - d. Stockham
 - e. Milwaukee
 - f. Or equivalent manufacturer.
 2. For use in general service and all areas unless otherwise specified:
 - a. Gate Valves:
 - i. Screwed or solder end, bronze body, rising stem, solid bronze disc, 300 psi CWP
 - (1) Threaded: Nibco T-111-LF, Stockham LFB-103, Apollo 101T-LF, or equal.
 - (2) Solder: Nibco S-111-LF, Stockham LFB-104, Apollo 101S-LF, or equal.
 - b. Globe Valves:
 - i. Screwed or solder end, bronze body, PTFE disc, 300 psi CWP.
 - (1) Threaded: Watts LFGLV, Milwaukee UP502, Apollo 120T-LF, or equal.
 - (2) Solder: Watts LFGLVS, Milwaukee UP1502, Apollo 120S-LF, or equal.
 - c. Check Valves:
 - i. Screwed or solder end, bronze body, PTFE disc, 300 psi CWP.
 - (1) Threaded: Nibco T-413-Y-LF, Stockham LFB-319Y, Apollo 161T-LF, or equal.
 - (2) Solder: Nibco S-413-Y-LF, Stockham LFB-309Y, Apollo 161S-LF, or equal.
 - d. Ball Valves:
 - i. Acceptable in lieu of gate and globe valves for 2 inch and smaller.
 - ii. MSS SP-110, full port bronze ball, threaded or solder ends, 2-part bronze body, reinforced PTFE or equal resilient seat, blowout-proof stem, lever handle, 600 psi CWP.
 - (1) Threaded: Watts LFFBV-3C, Stockham LF-T-255, Apollo 70LF-100, or equal.
 - (2) Solder: Watts LFFBVS-3C, Stockham LF-S-255, Apollo 70LF-200, or equal.
 - E. Insulation: As specified in "Pipe and Equipment Insulation" Section in this Division.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide offsets in all piping to place in proper position and avoid work of other trades.
- B. The supply lines or fittings for every plumbing fixture shall be so installed as to

- prevent backflow.
- C. Install all valves with stems horizontally to upright. Do not install with stems down.
 - D. Adjust pressure reducing valve, and tempering valve as directed by the Engineer.
 - E. Where plastic piping joins metal piping, threaded adapters shall be installed only with plastic male into metal female.
 - F. Install piping free of sags, bends, and kinks.
 - G. Solder joints: solder joints shall be made in accordance with ASTM B 828. The temperature of the joint during soldering shall not be raised above the maximum temperature limitation of the flux.
 - H. Threaded joints: threaded joints shall have pipe joint compound or teflon tape applied to the male threads only. Tighten joint with a wrench and backup wrench as required.
 - I. Press connections: copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully inserted in the fitting. The joints shall be pressed using the tools approved by the manufacturer.

3.2 TESTING

- A. Perform pressure testing on all piping and equipment in accordance with Section 15400.

END OF SECTION

SECTION 15444NATURAL GAS SYSTEMPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Work Included: Furnish, install, and test a natural gas system within the building to a point outside the building in the location of the gas meter, including final connection to the meter; coordinate requirements and service location with local gas utility prior to installation. Refer to additional requirements in specification Section 15400.

1.2 QUALITY ASSURANCE

- A. The entire installation shall conform to NFPA 54, current edition, as well as codes and regulations adopted by the Project State and local jurisdiction.
- B. Installation, testing, and replacement of gas piping, appliances, or accessories, repair, and servicing of equipment, shall be performed only by gas fitters licensed in the Project State.
- C. Standards (Piping):
 - 1. Extruded Polyethylene Gas Piping: ASTM D2513.
 - 2. Steel Pipe: ASTM A53.
- D. Standards (Fittings & Couplings):
 - 1. Extruded Polyethylene Gas Fittings: ASTM D2513.
 - 2. Malleable Iron, Threaded fittings: ASME B16.3.
 - 3. Valves, fuel gas service: ASME B16.33.

1.3 SUBMITTALS

- A. General: Submittals shall be in accordance with specification Sections 01340 and 15400.
- B. When state or local codes require licensed gas fitters to install the natural gas system, submit notarized copies of licenses of all gas fitters who will perform the installation.

PART 2 - PRODUCTS2.1 MATERIALS

- A. All materials shall be in accordance with NFPA 54 and all state and local codes.
- B. Buried piping:
 - 1. Piping: Extruded polyethylene, 150 psi, butt-fusion fittings.
 - 2. Transition fittings: Plastic-to-steel anodeless riser with 7 to 12 mil epoxy coating on exposed metallic surfaces.
- C. Aboveground piping:
 - 1. Less than 1/2 inch:
 - a. Type "K" soft or hard temper copper tube with AGA approved gas tubing fittings or brazed fittings.
 - 2. 1/2 inch and larger:
 - a. Piping: Schedule 40 black steel, threaded ends.
 - b. Fittings: Malleable iron, threaded.

- c. Joining method: UL listed graphite joint sealing compound for gas service or tetrafluoroethylene tape, applied to male threads only.
- d. Valves: Full port bronze ball, threaded ends, 2-part bronze body, reinforced PTFE or equal resilient seat, blowout-proof stem, lever handle, 600 psi CWP. UL approved for use in fuel gas applications. Apollo 94ALF-A, Nibco T-580-70-UL, Stockham T255, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Clean pipe before installation.
 - 2. Remove internal scale.
 - 3. Ream pipe ends after cutting.
 - 4. For screwed joints, apply noncorrosive, non-hardening Teflon pipe thread compound or Teflon tape to male threads only.
 - 5. Install gas piping and accessories in accordance with NFPA 54.
 - 6. Buried polyethylene pipe shall be marked with acceptable marking system with marking tape no more than 6" below grade. Marking system shall also incorporate a tracer wire running adjacent to buried pipe. Minimum depth of pipe and tracer wire shall be 24" below grade.
 - 7. Install gas piping parallel with building walls or structure. The lower end of all vertical supply piping near equipment shall terminate with a tee, minimum 3-inch-long nipple, and cap to serve as a sediment trap.
 - 8. Install a gas cock and union in the pipe adjacent to each appliance, in such a manner that the appliance may be removed without disturbing the gas piping.
 - 9. Hangers, supports, and anchors shall be installed according to NFPA 54.
- B. Gas Service: Tie into gas meter provided by local gas company at the building.
- C. Gas pipe sizes are based on the terminal equipment to be connected, and their distance from the gas meter/regulator assembly. Confirm line sized based on NFPA 54 sizing criteria for the terminal equipment provided on the job prior to the start of the installation.
- D. Purging: After piping has been tested, the Contractor shall fully purge the gas piping in accordance with NFPA 54.

3.2 TESTING

- A. Perform pressure testing on all piping and equipment in accordance with Section 15400.

END OF SECTION

SECTION 15492

SUBMERSIBLE SUMP PUMP

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish and install submersible type sump pump and sewage ejector of type, capacity, and at location as shown on the Drawings and as specified herein. Refer to additional requirements in specification Section 15400.

PART 2 - MATERIALS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
1. Zoeller Pump Company
 2. Weil Pump Company
 3. Liberty Pump Company
 4. Barnes Pumps
 5. Or equivalent manufacturer.

2.2 SUMP PUMPS

- A. Simplex Sump Pump:
1. Pump: Submersible solids handling type sump pump with cast iron casing, cast bronze impeller, stainless steel motor pump shaft, bronze fitted construction, and mechanical seals. 1-1/2" IPS discharge minimum, as shown on the Drawings. Capable of passing 3/4" spherical solids. Epoxy powder-coat finish.
 2. Motor:
 - a. Ball bearing designed for operation while totally submerged in water.
 - b. Built-in thermal overload protection.
 - c. Stainless steel shaft and fittings.
 3. Control: Integral non-mercury float control, 10-foot-long waterproof grounding type electric cable.
 4. Size, capacity, and electrical characteristics as shown on the drawings.
 - 5.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install where shown on drawings.
- B. Provide a gate valve and a check valve in discharge pipe above sump pump.
- C. Provide a union on the pump side of the gate valve to permit removal of pump unit.
- D. Extend discharge as shown on the drawings.
- E. Adjust controls for proper operation.
- F. Verify electrical outlet provided for pump meets Division 16 requirements for location. Outlet provided must be GFCI rated.

3.2 TESTS

- A. Test operation of pump and controls under actual working conditions in presence of the Engineer.

END OF SECTION

SECTION 15600HVAC - GENERALPART 1 - GENERAL1.1 DESCRIPTION

- A. Perform the following items of work required to complete the work of this Section, as shown on the drawings and specified herein:
 - 1. All labor, materials, equipment, and transportation shall be provided as required to completely furnish, install, and test the Heating, Ventilating, and Air Conditioning systems, with all connections as shown on the drawings and described in these specifications or as required by the Mechanical Code of the Project State. The accompanying drawings do not show every detail of ductwork, dampers, pipe, valves, fittings, hangers, equipment, and fixtures which are necessary for the complete installation but are provided to show the general arrangement and extent of work to be performed. Provide all work as indicated on the drawings together with all items necessary for or incidental to the completion of the work.
- B. Work included: The Heating, Ventilating, and Air Conditioning work shall include, but not be limited to the following, refer to requirements specified in Division 15:
 - 1. Heating system piping, valves, supports, and specialties.
 - 2. Heat generation and transfer equipment.
 - 3. Ductwork and devices.
 - 4. Air moving and air handling equipment.
 - 5. Automatic temperature control systems.
 - 6. Pipe and equipment insulation.
 - 7. Balancing air and water systems.
 - 8. Connections to equipment installed by other trades.
 - 9. Installation of components and devices furnished by other trades that are located in Heating and Ventilating piping, ducts, or equipment.
- C. Drawings and Measurements:
 - 1. The Drawings show the general arrangement, direction, and sizes of pipes, ductwork, and equipment. They are not intended to show every offset, valve, and fitting, and every structural difficulty that may be encountered.
 - 2. Coordinate HVAC system installation with the work of other trades.
 - 3. Verify measurements at the job site.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

- A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
- B. Electrical Work:
 - 1. The HVAC work shall include the installation of all motors, temperature controls, limit switches, etc., as herein specified. All 480-volt, 208-volt, and 120-volt wiring and connections, and all motor starters, not specified in this Section, will be provided under Division 16 - Electrical.

2. All 24-volt wiring and auxiliary devices required for the specified systems, equipment and operations indicated in this Section shall be provided under this Section, unless specifically indicated on the Drawings related to Division 16 - Electrical. This shall include, but is not necessarily limited to, all wiring for automatic temperature and damper modulation control.
3. The materials and methods for all electrical work provided under this Section shall comply with the requirements specified under Division 16 - Electrical. Coordinate equipment ratings, starter sizes, protective device sizes, wire and conduit sizes, holding coil voltages and control voltages with Division 16.

1.3 QUALITY ASSURANCE

- A. Materials and Workmanship: All materials and workmanship shall be suitable for the respective work and the type of service encountered. The contractor shall use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Division.
- B. Equipment: All equipment shall be constructed to operate safely without undue wear.
- C. Local Codes: Install all systems in accordance with applicable state and local codes; in the event of conflict between or among specified requirements and pertinent regulations and/or codes, the more stringent requirement will apply.
- D. Permits: Arrange for all permits, inspections, and tests required by codes at no additional cost to the Owner.
- E. Standards: When standards are referred to, the latest issue shall apply.

1.4 JOB CONDITIONS

- A. Scheduling Work: Install and test all materials to be cast into or buried under concrete floor slabs prior to the placement of concrete.

1.5 SUBMITTALS

- A. Provide shop drawings in accordance with the requirements of the General Conditions, Section 01340, and as specified herein. Shop drawings shall contain the following information at a minimum:
 1. Completed Submittal Certification Form. Shop drawing submittals will be returned unreviewed without this form.
 2. Manufacturer's literature and illustrations for all equipment and materials to be installed indicating all capacities, performance requirements, electrical characteristics, options, and accessories as shown on the drawings and as specified in each Section.
 3. Guarantees/Warranties as specified in each Section.
- B. Operations and Maintenance Manual: Provide Operations and Maintenance Manual for all mechanical equipment as specified in the General Conditions. Refer to Operation and Maintenance section of specification 01340 for all other requirements for submissions to engineer. Operations and Maintenance Manual shall contain the following information at a minimum:
 1. Manufacturer's operation & maintenance manuals with all non-applicable content removed or crossed out.

2. Table of Contents
3. Contractor and Manufacturer Contact Information.
4. Operator service requirements including Preventative Maintenance Schedule and Summary.
5. Troubleshooting Information.
6. Warranty Information.
7. Shop Drawings corrected to As-Built Conditions.
8. Wiring and Control Diagrams.
9. Parts and Service Contact Information.
10. List of All Component Part Numbers.
11. Spare Parts and Supply Lists.
12. Completed Operations and Maintenance Manual Certification Form at the start of each section for all equipment provided.
13. Complete the following table for all equipment installed and include following the Table of Contents for all installed equipment or at the beginning of each section for the equipment in that section:

Equipment Name	Unit Tag	Serial Number	Model Number	Building / Location	Date Installed

1.6 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Section 01600.
- B. Exercise care during loading, transporting, unloading, and handling to prevent damage of any nature to interior and exterior surfaces of equipment and materials.
- C. Store materials on the project site in enclosures or under protective coverings.
- D. Assure that all materials are kept clean and dry.
- E. Do not store materials directly on the ground.
- F. The Contractor shall be responsible for the care and protection of all materials and mechanical work until the project is accepted by the Owner.
- G. Immediately remove from the construction site all materials damaged and/or destroyed and replace with new materials to the complete satisfaction of the Engineer without additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide and install only new materials and equipment and of the latest design of the respective manufacturers.
- B. All materials and equipment of the same classification shall be the product of the same manufacturer unless otherwise specified.
- C. Provide all electrical specialties and accessories as specified with the equipment in accordance with requirements of Division 16. All specialties and accessories shall meet the NEMA Electrical Classification of the space in which they are installed. See Drawing Sheet E-1 for the NEMA Schedule.
- D. Furnish to the proper trades, all manufacturer's wiring diagrams for installation of mechanical equipment.

- E. Provide tee fittings, elbows, reducers, sheet metal safing, and other required components to install equipment and control devices furnished by other trades.
- F. Furnish and install all necessary supports and bases for all items furnished under HVAC as required for the specific item/equipment to provide alignment to adjacent inlet and outlet interconnecting piping and/or ductwork. In the absence of specific details within the Contract Documents for the supports and bases, submit proposal outlining supports/bases for the specific item/equipment being provided including materials of construction, size, components and other necessary details for review and acceptance by the Engineer. Materials of construction shall be suitable for the intended operating environment. Standard 4-inch concrete housekeeping pads are not included within this specification and are furnished by others.

2.2 BOLTS, ANCHOR BOLTS, NUTS, UNISTRUT, HANGERS, AND SUPPORTS

- A. Furnish all necessary bolts, anchor bolts, nuts, washers, lock washers or locking nuts, plates and bolt sleeves in accordance herewith. Anchor bolts shall have suitable washers, lock washers and, where so required, their nuts shall be hexagonal.
- B. All bolts, anchor bolts, nuts, washers, lock washers, plates, bolt sleeves, duct and pipe hangers and supports shall be constructed of the following materials:
 - 1. Galvanized steel in accordance with Division 5 unless otherwise indicated below or specified elsewhere.
 - 2. Stainless steel hardware (minimum of Type 304, unless otherwise indicated) is required in all corrosive atmospheres, exterior areas, and/or areas with NEMA 4X or NEMA 7 rating.
 - 3. Stainless steel hardware (minimum of Type 316, unless otherwise indicated) is required in all heavy moisture or submerged applications as well as in wetwells, headworks, dewatering rooms, chemical rooms; and enclosed clarifiers, aeration basins, or storage tanks, etc. For additional description and definition of submerged surfaces refer to Specification Section 09900.

2.3 EQUIPMENT AND VALVE TAGS

- A. Identify all new HVAC equipment shall be identified with a color coded equipment/valve tag. Submit a complete list of proposed Identification Tag information for review by the Engineer and Owner. Tag information shall match the information provided on the Drawings.
- B. Tags shall conform to the following specifications:
 - 1. 2.5-inch diameter, 1/16" thick, rigid, multi-layered sandwich laminate with contrasting inner and outer colored acrylic plastic layers. 5/32" top hole for hanging tags.
 - 2. Tags shall be black or red unless otherwise specified.
 - 3. Tags shall have up to three lines engraved on the outward facing side, with eight characters per line of identification information.
 - 4. Valve tags shall be secured to valves with adjustable stainless steel bead chain.
 - 5. Tags secured to equipment shall be fastened to a flat visible surface by a minimum of two stainless steel screws or stainless steel pop rivets.
 - 6. Tags shall be rated to withstand temperatures from -40°F to 175°F
 - 7. Manufacturers:
 - a. Seton Name Plate Corporation

- b. Brimar Industries
- c. Supreme Instrument & Electrical Services
- d. Equivalent Manufacturer

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all work in a neat workmanlike manner.
- B. Make all installations structurally sound throughout.
- C. All equipment and appurtenant components shall be installed in strict accordance with the manufacturer's written instructions, recommendations and as shown on the drawings.
- D. Supports: Support ductwork and piping in accordance with the mechanical code. Hanger and support materials shall be as indicated in paragraph 2.2.B of this section.
- E. Expansion: Provide provision for expansion of pipelines.
- F. Do not install piping through, directly over, or in front of electrical switchgear and power panels.
- G. Caulk the spaces between the duct or pipe and walls, ceilings, and floors gas-tight where shown on the Drawings.
- H. Coordinate locations of piping, sleeves, inserts, hangers, equipment, and access provisions with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities.
- I. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- J. Coordinate locations of structural systems necessary for duct, pipe, and equipment support to permit proper installation.
- K. Coordinate locations of duct and pipe sleeves, trenches and chases with duct, piping, and equipment locations.
- L. Core holes through concrete and masonry using rotary core drill. Locate holes to avoid interference with structural members such as beams or grade beams. Lay out holes in advance and perform drilling only after approval by the Engineer. Obtain approval in advance by the Engineer for drilling holes through structural members.
- M. Gauges and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms.
- N. Locate all installations to avoid interference with cranes and materials handling equipment, storage areas, work of other trades, and traffic areas.
- O. Perform all work incidental to the installation of the apparatus and materials including, but not limited to, cutting, patching, trenching, excavating, backfilling, trench covering, plastering and the constructing of chases, slots, furring, foundations, piers, and pads, when applicable. All work shall be performed in accordance with the applicable Divisions of this Specification by qualified workers regularly employed in the applicable trades.

3.2 TESTING

- A. When the installation is complete, test pipelines in the presence of the Engineer and the Plumbing or Building Inspector in accordance with the requirements of the local

- and state mechanical codes. Provide necessary testing equipment and utilities.
- B. Test underground piping prior to backfilling.
 - C. Test piping prior to application of paint and insulation.
 - D. Separately test portions of piping which will be concealed before completion.
 - E. Procedure:
 - 1. Piping Which Carries Water or Liquid Under Pressure: Fill pipes with water and subject them to 100 psig. or 1-1/2 times the normal working pressure, whichever is greater, for two (2) hours with no loss in test pressure.
 - 2. Isolate equipment that cannot withstand test pressures prior to any testing.
 - 3. Do not test plastic piping with compressed air or other gases.
 - F. Repairs:
 - 1. Should leaks be found, repair as required even to the extent of disassembling and remaking the joints or replacing sections of pipe.
 - 2. Do not repair leaks through the application of external caulking at joint surfaces or the use of chemical compounds.
 - 3. Replace defective pipe and fittings and repeat tests until the testing results are approved by the Engineer.

3.3 CLEANING

- A. Do not allow refuse and surplus materials to accumulate and obstruct the construction site.
- B. Upon completion of the installation, remove refuse and surplus materials from the construction site and leave the building neat and clean.

3.4 PAINTING AND IDENTIFICATION

- A. All HVAC piping shall be identified by this Contractor through the use of vinyl pressure sensitive markers. Markers shall indicate system, using abbreviations supplied by Engineer. Each system shall use a different color marker.
- B. Flow arrows shall indicate direction of fluid flow.
- C. Labels and arrows shall be provided at twenty-foot intervals and in or above each room.
- D. Paint HVAC piping, valves, pumps, and equipment in accordance with Specification Section 09900.
- E. Apply signage and identification in accordance with specification section 10140.

3.5 OPERATOR TRAINING

- A. Operator Training shall be performed by a duly authorized representative of the HVAC contractor, who is fully trained in the installation, startup, and operation of the installed equipment.
- B. Provide combined training and operational assistance for plant operators in the proper operations of the mechanical system equipment, and in the techniques, methods, schedules, etc. associated with maintenance.
- C. The level of the training and operational assistance provided shall be as required to ensure proper understanding of the equipment's operations, maintenance, and warranty conditions. Should the representative require time in addition to the minimums indicated herein to sufficiently detail the proper operations and maintenance of the equipment, it will be provided at no additional cost to Owner.

Under absolutely no circumstances shall warranties become void due to Owner's failure to follow operational and maintenance procedures which were not fully detailed and described in Owner's representatives during these sessions.

- D. At the Owner's discretion, the training sessions may be video recorded for Owner's future use.
- E. The contractor's representative shall fill out the Operator Training Certification form included within this Section. Training will not be considered complete until this form has been provided to the Engineer.

3.6 BALANCING

- A. Balancing of air and water system flows shall be in accordance with Section 15907.
OPERATOR TRAINING CERTIFICATION

Owner: _____ Date: _____

Project: _____

Contractor: _____

Equipment: _____

Specification Numbers: _____

I, the undersigned System Provider's Authorized Representative, have trained the Owner's personnel listed below in the proper operation and maintenance of the above listed equipment.

(System Provider's Authorized Representative/ Signature & Printed Name) (Date)

(Owner's Representative/ Signature & Printed Name) (Date)

(Witnessed by Engineer/ Signature & Printed Name) (Date)

END OF SECTION

SECTION 15601HYDRONIC HEATING SYSTEMS
PIPING AND SPECIALTIESPART 1 - GENERAL[XXX]1.1 DESCRIPTION

- A. Work Included: Provide and install a complete hot water heating system including all the required specialties and appurtenances as shown on the Drawings and as specified herein. Refer to additional requirements in specification Section 15600.

1.2 QUALITY ASSURANCE

- A. Standards (General):
 - 1. ANSI/UL 263
 - 2. ANSI/UL 2846
- B. Standards (Piping):
 - 1. Copper Tubing: ASTM B88.
- C. Standards (Fittings & Couplings):
 - 1. Copper Solder fittings: ASTM B16.18, ASTM B16.22.
 - 2. Copper Press fittings: ASME B16.51 and IAPMO PS 117.
- D. Standards (Instruments):
 - 1. Thermometers: ASTM E1
 - 2. Pressure Gauges: ASME B40.100.

1.3 SUBMITTALS

- A. Submittals shall be in accordance with specification Section 01340 and 15600.

PART 2 - PRODUCTS2.1 MATERIALS

- A. General: Manufacturers' names given below are intended to identify type and style. Products of other manufacturers may be acceptable upon the approval of the Engineer.
- B. Pipe:
 - 1. Up to and including 2-1/2-inch:
 - a. Type "L" copper tube with solder or press fittings.
- C. Solder and Flux:
 - 1. Solid string or wire solder, 95 percent tin, 5% antimony on all pressure piping and potable water piping.
 - 2. Silver solder, 45% brazing silver alloy (where indicated).
 - 3. Flux: Non-corrosive paste type as required for type of solder.
- D. Press Fittings for Copper Pipe and Tube:
 - 1. Acceptable Manufacturers:
 - a. Viega.
 - b. Mueller.
 - c. Nibco.

- d. Elkhart.
- e. Apollo.
- f. Or approved equal.
- 2. Shall conform to the material requirements of ASME B16.51.
- 3. Shall conform to the performance criteria of IAPMO PS 117.
- 4. EPDM, FKM or HNBR factory installed sealing elements, selected based on manufacturer's approved application guidelines.
- 5. Fittings shall be installed using the proper tool, jaws, and rings as instructed by the manufacturer.
- E. Valves (Up to and including 2-1/2-inch):
 - 1. Acceptable Manufacturers:
 - a. Nibco
 - b. Watts
 - c. Apollo
 - d. Stockham
 - e. Milwaukee
 - f. Or approved equal.
 - 2. For use in general service and all areas unless otherwise specified:
 - a. Gate Valves:
 - i. Screwed or solder end, bronze body, rising stem, solid bronze disc, 300 psi CWP
 - ii. Threaded: Nibco T-111, Stockham B-100, Apollo 101T, or equal.
 - iii. Solder: Nibco S-111, Stockham B-109, Apollo 101S, or equal.
 - iv. Globe Valves:
 - v. Screwed or solder end, bronze body, PTFE disc, 300 psi CWP.
 - vi. Threaded: Nibco T-211-Y, Stockham B-13-T, Apollo 120T, or equal.
 - vii. Solder: Nibco S-211-Y, Stockham B-14-T, Apollo 120S, or equal.
 - b. Check Valves:
 - i. Screwed or solder end, bronze body, Buna-N disc, 300 psi CWP.
 - ii. Threaded: Nibco T-413-W, Stockham B-320-B, Apollo 161T, or equal.
 - iii. Solder: Nibco S-413-W, Stockham B-310-B, Apollo 161S, or equal.
 - c. Ball Valves:
 - i. Acceptable in lieu of gate and globe valves for 2-inch and smaller.
 - ii. MSS SP-110, full port bronze ball, threaded or solder ends, 2-part bronze body, reinforced PTFE or equal resilient seat, blowout-proof stem, lever handle, 600 psi CWP.
 - iii. Threaded: Watts FBV-3C, Stockham T-255, Apollo 70-100, or equal.
 - iv. Solder: Watts FBVS-3C, Stockham S-255, Apollo 70-200, or equal.
 - 3. For use in designated areas with corrosive atmospheres as listed in paragraph 2.2:
 - a. Gate Valves:
 - i. Screwed end, 316 stainless steel body, non-rising stem, solid wedge disc, 200 WOG.

- (1) New Line N10055-SS, Sharpe 30276TE, FNW 15B-200, or equal.
 - b. Globe Valves:
 - i. Screwed end, 316 stainless steel body, 316 stainless steel disc, 200 WOG.
 - (1) New Line N10220-SS, Sharpe 40276TE, FNW 17B-200, or equal.
 - c. Check Valve:
 - i. Screwed end, 316 stainless steel body, 316 stainless steel solid disc, 200 WOG.
 - (1) New Line N10070-SS, Sharpe 20276TE, FNW 16B-200, or equal.
 - d. Ball Valves:
 - i. Acceptable in lieu of gate and globe valves for 2 inch and smaller.
 - ii. MSS SP-110, full port stainless steel ball, threaded ends, 2-part 316 stainless steel body, reinforced PTFE or equal resilient seat, blowout-proof stem, lever handle, 1000 psi CWP.
 - (1) Watts S-FBV-1, Stockham T-2852-SS, Apollo 76F-100, or equal.
- F. Strainer:
 - 1. "Y" Pattern: Bronze or cast iron body, screw or flange ends, 250 psi body, stainless steel screen of 40 mesh.
 - 2. Basket Type: Bronze or cast iron body, clamped cover, 125 psi working pressure, perforated brass basket.
- G. Air Separation:
 - 1. Size and capacity as indicated on the drawings.
 - 2. Full flow coalescing air separator, cast brass body, stainless steel or copper coalescing medium, full port float actuated brass venting mechanism, 150 psig working pressure. Spirotherm Spirovent VJ, Bell & Gossett EASB-JR, Caleffi 551 DISCAL, or equivalent product.
- H. Pressurized Expansion Tank:
 - 1. Size and capacity as indicated on the Drawings.
 - 2. Carbon steel shell designed and constructed per ASME Section VIII.
 - 3. Heavy-duty butyl rubber diaphragm or bladder, as indicated on the Drawings, removable for inspection or replacement.
 - 4. Working pressure – 125 psig.
 - 5. Operating temperature – 240°F.
 - 6. Vertical floor mounted style.
 - 7. Diaphragm
 - a. Wessels NTA
 - b. Amtrol AX-Series
 - c. Bell & Gossett Series D
 - d. Or equivalent product
- I. Make-up Water Pressure Reducing Valve: Brass body with anti-siphon check valve, integral strainer, field adjustable spring, 12 PSI setting. Watts LF123LP, Bell & Gossett FB-38, Taco 335, or equivalent product.

- J. Make-up Water Reduced Pressure Zone Backflow Preventer:
 - 1. Double spring-loaded check valve assembly with automatically operating reduced pressure relief valve located in the pressure zone between the two check valves.
 - 2. All bronze construction with stainless steel internals, union or flanged connections.
 - 3. Inlet and outlet gate valves and inlet strainer.
 - 4. Test cocks on inlet, relief, and outlet pressure zones.
 - 5. N.S.F. and A.S.S.E. tested and approved.
 - 6. Air gap drain.
 - 7. Watts #LF009, FEBCO #LF860, Wilkins #975XL, or equivalent product.
- K. Self-Contained Thermostatic Valve:
 - 1. Two-part construction.
 - a. Thermostatic operator consisting of dial and control valve.
 - b. Bronze valve body with EPDM rubber disc, with packing gland assembly capable of replacement while the system is in operation.
 - 2. Equal to Danfoss RA 2000.
- L. Triple Duty Valves:
 - 1. Acceptable in lieu of gate, check and balancing valve on discharge of each pump:
 - 2. Smaller than 2-inch:
 - a. Straight pattern, non-adjustable design.
 - b. Calibrated ball valve design.
 - c. MNPT threaded or rotatable flange inlet connection and a FNPT threaded outlet connection.
 - d. Spring-loaded check valve to prevent gravity circulation and backflow.
 - e. Calibrated nameplate with memory stop to allow the valve to be re-set to its balanced position after shut-off.
 - f. Capable of complete shut-off under pressure.
 - g. Extended handle and extended pressure/temperature ports.
 - h. Brass valve body.
 - i. Chrome plated brass valve ball.
 - j. Glass filled Noryl check valve body.
 - k. Stainless steel check valve spring.
 - l. EPDM rubber check valve seals.
 - m. Rated for 200 psi maximum operating pressure.
 - n. Temperature range of -4°F to 250°F.
 - o. Bell & Gossett Model 3DV or equivalent product by Armstrong, Aurora, or equal.
 - 3. 2-inch and larger:
 - a. Straight or angle pattern, non-adjustable design.
 - b. Globe valve design.
 - c. Spring-loaded check valve design to prevent gravity circulation and backflow.
 - d. Calibrated nameplate with multi-turn stem.

- e. Rubber memory button to allow the valve to be re-balanced to its original position after shut-off or maintenance.
 - f. Fully backseating disc to allow the valve packing to be replaced while under pressure.
 - g. Cast or ductile iron valve body.
 - h. Brass valve disc with EPDM rubber seat.
 - i. Stainless steel valve stem.
 - j. Stainless steel valve spring.
 - k. Available with either flanged end connections or grooved end connections.
 - l. Flange end connections should be designed according to ANSI Class 150 Standards.
 - m. Valve models with flange x flange end connections shall be rated for 175 psi maximum working pressure. Models with groove x groove end connections should be rated for 300 psi working pressure.
 - n. The valve shall have a maximum temperature rating of 250°F.
 - o. Equal to Bell & Gossett Model 3D or 3DS or equivalent product by Armstrong, Aurora, or equal.
- M. Vents:
- 1. Provide vents at all piping high points and where indicated.
 - 2. Automatic vents: cast brass or stainless steel, 150 psig design pressure, 270°F operating temperature, non-ferrous floats, stainless steel linkage, Viton seal which closes against a brass spring-operated seat, 1/2-inch or 3/4-inch connection. Provide gate valve between piping system and vent. Equal to Spirotherm Spirotop VTP050FT or VTP050SS or equivalent product by Watts, Caleffi, or equal.
 - 3. Manual vents shall consist of a minimum 3/4-inch air chamber with 3/8-inch piping and gate valve off top.
- N. Expansion Compensator:
- 1. Packless, externally pressurized type
 - 2. All welded construction
 - 3. Multiple ply stainless steel bellows
 - 4. Integral guide rings
 - 5. Internal liner
 - 6. Guiding and anchoring per EJMA recommendations and guidelines.
 - 7. Copper:
 - a. Pressure rating of 150 psi at 400°F
 - b. Rated for 1-3/4-inch compression and 1/4-inch extension
 - c. Female copper tube sweat ends
 - d. Stainless steel shroud
 - e. Optional anchor base may be provided to act as intermediate anchor.
 - f. Equal to Metraflex HPFF2 or equivalent product by Flexonics, Kelco, or equal.
- O. Balancing/Flow Measuring Valve:
- 1. 1/2-inch – 2-inch sweat; 1/2-inch – 3-inch NPT thread:
 - a. Lead free brass valve body

- b. Integral 304 stainless steel ball valve with glass and carbon filled TFE seat rings.
 - c. Two differential pressure read-out ports across valve seat area with internal EPT inserts / check valves.
 - d. 1/4-inch NPT tapped drain/purge port.
 - e. Calibrated nameplate with memory stop.
 - f. Reduced port design that provides velocity head recovery.
 - g. Temperature range from -4°F to 250°F.
 - h. Rated for 300 PSIG working pressure
 - i. Bell & Gossett Circuit setter model CB, RF, or MC or equivalent product by Armstrong, Watts, or equal.
- P. Pressure Relief Valve:
 - 1. Diaphragm operated, ASME rated in BTU/hr.
 - 2. Capacity shall exceed the maximum heating capacity of the protected device by 110% minimum. Set point shall be equal to or less than the normal working pressure of the protected device.
 - 3. Fluid shall not discharge into valve chamber.
 - 4. Valve seat and all moving parts exposed to the fluid are to be of non-ferrous material.
 - 5. Low blow-down differential.
 - 6. Bell & Gossett model 790, 1170, 3301, or 4100 or equivalent product by Armstrong, Watts, or equal.
- Q. Packaged Glycol Feed System:
 - 1. Prefabricated, automatic and autonomous make-up package to the glycol system:
 - a. Graduated polyethylene solution container.
 - b. Integral autonomous pumping assembly.
 - c. Alarm kit with panel and float.
 - d. Pressure tank with pressure control
 - e. Pressure reducing valve
 - f. Pressure gauge
 - g. System isolation valve.
 - h. Wessels G -18 or equivalent product by Axiom, Calefactio, or equal
- R. Instruments:
 - 1. Acceptable Manufacturers:
 - a. Trerice.
 - b. U.S. Gauge.
 - c. Taylor.
 - d. Or approved equal.
 - 2. Thermometers:
 - a. Provide brass immersion thermowells where indicated on the drawings.
 - b. Provide two additional immersion thermometers suitable for all thermowells for use in balancing and by operating personnel.
 - c. Provide and install where indicated on the drawings 9-inch separable socket liquid in glass thermometer with a range of 30 to 240°F. Provide adjustable angle type where required for proper visibility.

3. Pressure Gauges:
 - a. Provide pressure gauge connections where indicated consisting of ¼-inch take-off and isolation valve.
 - b. Provide -30-inch Hg to 100 PSI, 3-1/2-inch, cast aluminum pressure gauge where indicated.

2.2 DESIGNATED CORROSIVE AREAS

- A. Designated Areas Requiring Corrosion Resistant Materials:
 1. Wet Well

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide offsets in all pipe to place in proper position and avoid work of other trades.
- B. Erect all piping to provide for easy and noiseless circulation of hot water under all working conditions.
- C. Use inverted eccentric fittings to reduce the size of the water mains.
- D. Make proper allowances for the expansion and contraction of all piping. Anchor piping where necessary to control expansion.
- E. Install a sufficient number of unions for disassembling pipe around equipment.
- F. Weld all steel piping 3-inch and larger in size. Weld or install screwed fittings in pipe 2-1/2-inch and under in size.
- G. Install piping level or slightly pitched upward in the direction of flow so that no air pockets are formed in the piping. Provide vents at all piping high points and where indicated.
- H. Install pipe hangers to properly support all equipment and piping in accordance with the mechanical code of the Project State.
- I. Sleeves and Plates:
 1. Provide and install sleeves sized to provide 1/4-inch minimum annular space around pipes passing through masonry walls and floors. Allow all insulation to pass through sleeves except where gas-tight calking is required.
 2. Where exposed pipes pass through finished walls, floors, ceilings, etc. provide and set split cover plates.
- J. Drains:
 1. Provide drain valves where shown on the drawings, at all low points, and at all equipment.
 2. Drains shall be 1/2-inch hose valve style.
- K. Provide and install dielectric unions at junction of pipes of dissimilar metals.
- L. Provide and install control measurement and valves in piping systems that are supplied by other trades.
- M. Provide and install unions to allow removal of all control valves.
- N. When installation requires the connection of dissimilar metals dielectric unions shall be incorporated.

3.2 TESTING AND BALANCING

- A. Perform a hydrostatic pressure test on all piping and equipment in accordance with section 15600.
- B. Test pressure shall be 100 psi or 1-1/2 times the working pressure, whichever is greater.
- C. Repair, replace and rework, as required, to repair any defects and retest for approval.
- D. Perform all testing prior to installation of insulation. Test systems in sections as required to prevent delay of project.
- E. Balance the entire hydronic heating system in accordance with applicable sections of Division 1 and this Division.
- F. Operational Test: Upon completion of installation of all equipment and acceptance of tests and balancing, perform a 24-hour continuous operational test in the presence of the Engineers and Owner's representative to demonstrate proper operation of all functions of the equipment and system.

3.3 PAINTING AND IDENTIFICATION

- A. All heating system piping, valves, pumps, and equipment shall be painted and labeled in accordance with Specification Section 09900.

END OF SECTION

SECTION 15604AUTOMATIC TEMPERATURE CONTROL (ELECTRONIC)PART 1 - GENERAL1.1 DESCRIPTION

- A. Furnish, install, and test a fully functional electronic automatic temperature control (ATC) system of the type and function as required on the drawings and herein specified.
 - 1. All 24-volt (low voltage) wiring systems included for automatic temperature controls systems as part of this specification shall be installed by the Automatic Temperature Controls contractor.
- B. Coordination with Other Trades: The automatic temperature control trades shall coordinate and supervise other trades whose work affects the control systems, including but not limited to:
 - 1. Coordinate installation and wiring of air monitoring equipment furnished and installed under Division 13.
 - 2. Coordinate interconnections with SCADA system furnished and installed by Division 13 as shown on the drawings and described herein.
- C. Work Performed by Other Trades: The following incidental work shall be furnished by the designated trade under the supervision of the automatic temperature control (ATC) trade:
 - 1. The heating/cooling trades shall:
 - a. Install automatic valves and separable wells that are specified to be supplied as a portion of the control systems.
 - b. Furnish and install all necessary: valved pressure taps, water, drain and overflow connections and piping.
 - 2. The sheet metal trades shall:
 - a. Furnish and install all automatic dampers.
 - b. Provide necessary blank-off plates required to install dampers that are smaller than duct size.
 - c. Assemble multiple section dampers with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper motors.
 - d. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation and affix and seal permanently in place only after stratification problem has been eliminated.
 - e. Provide access doors or other approved means of access through ducts for service to control equipment.
 - 3. The electrical trades shall:
 - a. Install line-voltage electrical wiring systems (120 volt single phase, 240 volt single phase, 208 volt 3-phase or 460 volt 3-phase) in accordance with Division 16 requirements.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

- A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
1. Section 16075 – Conduit, Cable and Wiring Identification and Tagging
 2. Section 16160 – Cabinets and Enclosures
 3. Section 16900 – Controls

1.3 QUALITY ASSURANCE

- A. The system shall be installed, tested, and balanced by competent technicians regularly employed by the temperature control manufacturer.

1.4 SUBMITTALS

- A. Provide shop drawings in accordance with the requirements of the General Conditions, Section 01340, and as specified herein. Shop drawings shall contain the following information at a minimum:
1. Manufacturer's literature for all equipment including maintenance and operating instructions and parts lists.
 2. Description of operation for all systems.
 3. Electric wiring diagrams showing all wiring, and equipment including all interconnections on a terminal to terminal basis. Refer to ladder wiring diagrams shown on the Drawings. Note any discrepancies due to actual system submitted.
 4. Panel layout drawings for all local and central panels (to scale).
 5. Valve and damper operator schedule showing size, configuration, capacity and location of all equipment.
- B. Operations and Maintenance Manual: Provide Operations and Maintenance Manual for all mechanical equipment as specified in the General Conditions. Refer to Operation and Maintenance section of specification 01340 for all other requirements for submissions to engineer. Operations and Maintenance Manual shall contain the following information at a minimum:
1. Manufacturer's operation & maintenance manuals with all non-applicable content removed or crossed out.
 2. Table of Contents
 3. Contractor and Manufacturer Contact Information.
 4. Operator service requirements including Preventative Maintenance Schedule and Summary.
 5. Troubleshooting Information.
 6. Warranty Information.
 7. Shop Drawings corrected to As-Built Conditions.
 8. Wiring and Control Diagrams.
 9. Parts and Service Contact Information.
 10. List of All Component Part Numbers.
 11. Spare Parts and Supply Lists.
 12. Completed Operations and Maintenance Manual Certification Form.

1.5 GUARANTEE

- A. The control system designated on drawings and plans and herein specified, shall be guaranteed to be free from original defects in both material and workmanship for a

period of one (1) year of normal use and service, excepting damages from other causes. This guarantee shall become effective starting the date the Owner begins to receive beneficial use of the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Honeywell
 - 2. Johnson Controls
 - 3. Schneider Electric
 - 4. Reliable Controls
 - 5. Automated Logic
 - 6. Siemens
 - 7. Or equivalent manufacturer.

2.2 MATERIALS

- A. General: The control system shall consist of enclosures containing the necessary standalone programmable controllers; all required, terminal strips, interposing relays, selector switches, and other ancillary components; as well as all sensors, thermostats, temperature transmitters, controllers, automatic valves and dampers, damper operators, control panels, and other accessory equipment to meet the intent of the specification and provide for a complete and operable system. Refer to Drawings for electrical wiring and interlocks.
- B. All panels and devices shall meet the NEMA electrical classification of the space in which they are installed. Refer to drawing Sheet E-1 for NEMA classification schedule.
- C. Standalone Controller:
 - 1. Protocols
 - a. BACnet
 - b. Supports one B/IP subnetwork and B/VPN.
 - c. Ethernet or MS/TP.
 - d. DHCP: Dynamic Host Configuration Protocol.
 - e. SMTP: Simple Mail Transfer Protocol:
 - f. Provides standard email communications for broadcasting email alarms.
 - g. Supports TLS/SSL security.
 - h. SNTP: Simple Network Time Protocol.
 - i. Wi-Fi on controllers with the -W option:
 - j. Supports WPA-Personal and WPA2-Personal security.
 - 2. Touchscreen Display
 - a. Display full-color graphics, runtime logs, trend logs, alarms, and schedules.
 - b. Full-color screen, 4.3" wide-quarter VGA, thin film transistor, projective capacitive touch; Display area 2 1/4" x 3 3/4".
 - 3. Universal Inputs
 - a. 12-bit A/D converter.
 - b. Analog: 0–10 VDC 4–20 mA, thermistor.

AUTOMATIC TEMPERATURE CONTROL (ELECTRONIC)

- c. Binary: Dry contact.
 - d. Impedance: $M\Omega$ for 0–10 VDC range, $250\ \Omega$ for 4–20 mA range, $20\ k\Omega$ pull-up for thermistor/dry contact range.
 - e. Pulse counting up to 150 Hz. Supports flow meters.
 - f. 24 VAC overvoltage protection.
- 4. Universal Outputs
 - a. 12-bit D/A converter.
 - b. Analog: 0–12 VDC.
 - c. Binary: Software-configurable between 0–12 VDC.
 - d. Maximum 75 mA each.
 - e. 24 VAC overvoltage and short protection.
- 5. Spare I/O
 - a. Controller shall be provided with spare inputs and outputs for connection of additional equipment and devices. Number of spare input and outputs will correspond to 20% of the total used, with a minimum of two inputs and two outputs.
- 6. Equivalent to:
 - a. Reliable Controls MACH-Pro
 - b. Automated Logic WebCTRL
 - c. Siemens Desigo
 - d. Or equal
- D. Electric Line-Voltage Industrial Thermostat:
 - 1. Industrial/heavy commercial grade, Line-Voltage type thermostats in NEMA 12, 3R, 4/4X process and production areas capable of directly activating heating or cooling equipment.
 - 2. Thermostat shall be wall mounted in a heavy-duty metal enclosure. The enclosure shall meet the NEMA requirements of the area in which they are installed. Minimum rating shall be dust tight, NEMA 12.
 - 3. Switching shall be SPST with a minimum rating of 16 Full Load Amps (FLA) and 80 Locked Rotor Amps (LRA) at 120 VAC or the full load rating of the device(s) to be activated, whichever is greater.
 - 4. Differential shall be fixed 3-5 deg. F.
 - 5. Bulbs shall be corrosion resistant, shielded and either locally or remote mounted as required.
 - 6. Covers shall have temperature set point adjustment knob except when concealed or removable key adjustment is noted. Scale range shall be 40 to 100 °F unless described otherwise in the control description under paragraph 3.1.
 - 7. In areas of a building that comply with the Americans with disabilities act, thermostats shall be mounted at a height of 48" above a finished floor.
- E. Industrial Temperature Controller:
 - 1. Industrial/heavy commercial grade, Temperature Controllers in NEMA 12, 3R, 4/4X process and production areas capable of controlling heating and cooling equipment through motor starters, variable speed drives, industrial relays or other equipment control devices.

AUTOMATIC TEMPERATURE CONTROL (ELECTRONIC)

2. The temperature controller shall be programmable for staged on-off heating and cooling control with front mounted program pushbuttons with LCD backlit display to show current temperature, setpoint and programming modes.
 3. Temperature controller shall be wall mounted in a metal enclosure. The enclosure shall meet the NEMA requirements of the area in which they are installed. Minimum rating shall be dust tight, NEMA 12.
 4. Power shall be 120 VAC with battery backup or programmed parameter stored in non-volatile memory.
 5. The controller will include a minimum of four (4) form C contacts rated a minimum of 5 amps at 120 VAC.
 6. Differential shall be programmable from 1-5 °F.
 7. Temperature sensor shall be a shielded and water tight platinum RTD temperature sensor mounted external to the control enclosure or remotely mounted as required.
 8. In areas of a building that comply with the Americans with disabilities act, thermostats shall be mounted at a height of 48" above a finished floor.
 9. Honeywell Model T775 or equivalent product.
- F. Commercial Room Thermostat:
1. Commercial grade thermostats in office and administrative areas capable of controlling heating, cooling and ventilation. Provide cover guards in publicly accessible areas.
 2. Low voltage temperature controllers shall be programmable for multistage 7-day heating and cooling control with front mounted program pushbuttons and LCD backlit display to show current temperature, setpoint and programming modes.
 3. Temperature controller shall be wall mounted.
 4. Power shall be 24/120 VAC with real time clock and battery backup or programmed parameter stored in non-volatile memory.
 5. Temperature sensor shall be a thermistor or RTD sensor internal to the unit.
 6. In areas of a building that comply with the Americans with disabilities act, thermostats shall be mounted at a height of 48" above a finished floor.
- G. Duct and Immersion Thermostats:
1. Duct and immersion thermostats of the single input type shall have integral setpoint adjustments and throttling ranges adequate for the application. Duct thermostats shall have sensing elements of sufficient length and accuracy to measure average duct temperature in each location.
 2. Controllers shall be designed and constructed for equipment room use and shall not be affected by ambient temperature and humidity.
 3. Duct mounted or immersion type shall have spans of one hundred degrees or two hundred degrees Fahrenheit as required. Averaging element sensors shall have a minimum nine-foot capillary element. Temperature sensors shall be of rigid stem using bimetallic sensing elements except where averaging is required.
 4. Sensors shall be of corrosion resistant construction, tamper proof, suitable for mounting on a vibrating surface. If capillary, shall be temperature compensated and armored or installed in protective tubing.

5. All sensing elements for water pipe mounting shall be furnished complete with separable protecting wells filled with heat conductive compound. Sensors shall be factory calibrated and tamper proof. If easily adjustable sensors are provided, they shall be located inside metal enclosures with cylinder lock and key to prevent unauthorized setting.
- H. Thermometers:
1. A thermometer shall be located adjacent to each rigid stem thermostat. A dual thermometer with liquid-filled remote system shall be mounted adjacent to each remote bulb thermostat. Averaging bulb thermometers shall be used where averaging bulb thermostats are required.
 2. Provide duct-type thermometers in all fresh air intake, mixed air, return air, and all supply fan discharges and elsewhere where noted or shown. Thermometers shall have the proper range scales for the locations where installed.
 3. Panel-mounted indicating thermometers shall be minimum two inches' diameter.
- I. Differential Pressure Controllers:
1. Static pressure regulators shall be direct or reverse acting as required with adjustable setpoint and throttling range with field calibration capability.
- J. Control Valves: Three-way, two-way, mixing, or diverting service as required. Operator shall be electric. Valve pressure drop shall not exceed 7 feet water column (w.c.). Control valves shall be sized by the ATC contractor.
- K. Dampers:
1. All control dampers shall be furnished as part of Section 15862.
 2. All dampers shall be installed by sheet metal trades.
 3. All dampers installed for outside air applications shall be low leakage design and construction. Refer to Section 15862 for minimum construction details.
- L. Damper Operators and Linkages:
1. Damper operators shall be electric open-close or fully proportioning as indicated or required.
 2. Linkages shall be suitable to connect operator to damper leaves and transmit full torque of motor. All necessary hardware shall be included with the linkages.
 3. Damper motors shall be quiet in operation and shall have ample power to overcome friction of damper linkage and air pressure acting on louvers to position dampers accurately and smoothly. The damper operator mounting arrangement shall be outside the airstream wherever possible.
 4. The operators shall be capable of operating at varying rates of speed to correspond to the dictates of the controllers and variable load requirements. The operators shall be capable of operating in sequence when required by the sequence of the operation. The operators shall have external adjustable stops to limit the stroke in either direction. The operator linkage arrangement shall be such as to permit normally open or normally closed positions of the dampers as required.
 5. Electric Operators:
 - a. On-off, reversing, or proportional as required.
 - b. Spring return to closed or open position as required.

6. Dampers associated with emergency generator cooling shall fail open on loss of electrical power.
- M. Electric Humidistats:
 1. Humidistats shall be line or low voltage with an adjustable setpoint range as indicated or required. Contacts shall be rated to handle the current load for the application.
- N. Miscellaneous Devices:
 1. Provide all the necessary relays, positioners, clocks, transformers, etc. to make a complete and operable system.
 2. Locate these devices on local panel unless specified otherwise.
- O. Miscellaneous Hand Switches and Indicator Lights:
 1. Size: 30 mm
 2. All indicator lights shall be 120V AC, LED with push to test option.
 3. Reference Section 16900 for additional specifications.
 4. Number of positions and nameplate legends shall be as indicated in Paragraph 3.1 of this specification.
 5. Selector switches shall be configured in the order listed; for example, a three position Hand-Off-Auto switch shall be configured such that the left position is "Hand", center position is "Off", and right position is "Auto".
- P. Relays:
 1. Pilot duty relays shall be Form C, UL listed, two (2) to four (4) pole relay with DIN rail mounted base rated a minimum of 5 amps at 120 VAC. Relay shall have indicator and mechanical test pushbutton.
 2. Industrial relays or contactors shall be used to directly drive 120 VAC single phase equipment.
 3. Refer to Section 16900 for additional requirements.
- Q. Panels:
 1. Panels shall be provided to enclose all relays, switches, and controllers as required.
 2. Panels shall be front access with gasketed, hinged covers with keyed tee handles.
 3. Required indicating and control devices shall be installed in the cover.
 4. Terminal strips shall be provided for all electrical connections.
 5. Enclosure shall be furnished with a corrosion resistant finish.
 6. Panels shall be central and/or local as indicated or required.
 7. Control Panels shall be provided in accordance with Section 16160.
 8. All Control and Industrial Panels shall be constructed in accordance with UL 508A standard. Refer to Section 16160-2.
 9. Control panel shall be provided with spare mountings for additional relays. Number of spare mountings will correspond to 5% of the total number of relays within each panel, with a minimum of one spare mounting.
 10. All wiring entering and leaving control panels shall be terminated on field terminal blocks and labeled.
- R. Gauges:
 1. Thermometers and pressure indicating gauges shall be provided as shown on the Drawings and other points throughout the system where the visual

indication of temperature or pressure is required or will prove beneficial to operating personnel in the operation of the control system. Gauges will not be required on room type thermostats.

S. Timer/Controller:

1. Repeat Reset Cycle Timers shall be rated 120 volts. The cycle shall automatically reset to origin upon loss of power. The "ON" timing circuit shall be continuously adjustable up to a period of 60 minutes. The "OFF" timing circuit shall be continuously adjustable up to a period of 10 hours. Both circuits shall have a minimum setting of 3% of range. Setting accuracy shall be 10% of range maximum. Timer life shall have a warrantee through 10,000,000 operations (no load). An LED cycle progress annunciator shall be provided with each timing circuit. Contacts shall be NO and/or NC as detailed on the Drawings, and shall be rated 7 amperes at 125 volts. Repeat, Reset cycle Timers shall be suitable for recessed panel mounting, and shall be Automatic Timing Controls 342 series, or equal.

T. Duct-mounted Airflow Switch:

1. SPDT paddle-type or thermal dispersion proof- of- airflow switch, for mounting in ductwork of ventilation equipment serving Class 1/Division 2 rated areas and Unclassified rated areas in accordance with NFPA 820.
 - a. Paddle type: Stainless steel paddle, range adjustment screw, 120 Volt, 16 FLS AC rated. Unit shall have NEMA 4X or NEMA 7 enclosure in areas requiring same. Furnish switch, for mounting in ductwork by mechanical contractor; provide wiring to ATC panel. Dwyer V4, or equivalent product by Johnson Controls, Omega, or equal.
 - b. Thermal dispersion: 316 Stainless steel sensor head, NEMA 4X and Class 1 Division 1&2 rated powder coated housing, 120VAC, 4W. Ameritrol FX, or equivalent product by Johnson Controls, Magnetrol, or equal.
2. Combination Horn/Strobe Unit: 24V, polycarbonate, NEMA 3R & 4X, pipe mounted multi-status LED beacon with tone module. The unit shall be powered and controlled by the associated ATC panel. The horn and strobe circuits shall be capable of independent operation. A flashing amber beacon shall be activated upon loss of ventilation. Edwards Signaling 108I-RGA-G1, Eaton, or equal.

PART 3 - EXECUTION

3.1 DESCRIPTION OF OPERATION

A. General:

1. Dehumidifier (DH):
 - a. Controlled by integral humidistat.
 - b. When the relative humidity at the humidistat rises above the setpoint (50% adj.), the unit shall be energized.
2. Hydronic Unit Heater (UH):
 - a. The wall mounted line voltage thermostat shall energize the fan as necessary to maintain the space temperature setpoint.
 - b. Space temperature setpoint – 55°F (adj.)

B. Boiler (B-ON1)

AUTOMATIC TEMPERATURE CONTROL (ELECTRONIC)

1. Boiler shall operate using manufacturer's unitary controls to maintain hot water system temperature setpoint according to the following hot water temperature reset schedule:

Outside Air Temperature (OAT)	Hot Water Supply Temperature (HWS)
50°F	100°F
40°F	115°F
30°F	130°F
20°F	145°F
≤10°F	160°F

2. IF the outside air temperature is less than 50°F THEN the boiler shall be enabled.
3. Boiler pump (BP-ON1) shall be controlled by the boiler unitary controls.
4. Circulating pump (CP-ON1) shall be energized whenever the boiler is enabled.
5. If the boiler pump proof-of-flow cannot be established, the boiler will not operate, and an alarm will be generated.
6. An alarm will be generated and boiler B-1 will not operate if any of the following conditions occur:
 - a. Low water cutoff switch closure.
 - b. Low gas pressure.
 - c. High water temperature.
 - d. High flue gas temperature.
 - e. High vent pressure.

C. Drywell Ventilation:

1. Controlled by the following associated with panel ATC-ON1:
 - a. Hand/Off/Auto switch
 - b. Light status relays (provided by Division 16). Provide wiring to dry contacts; coordinate locations with electrical contractor and electrical plans; refer to ATC riser diagrams for additional information.
 - c. Existing combustible gas detector (provide wiring to detector alarm panel dry contacts; coordinate connection as require to send signal to SCADA system to alert operator to alarm condition)
2. When the lights in the space served are energized, the space shall be considered occupied; when the lights are de-energized, the space shall be considered unoccupied.
3. IF the space is occupied OR the switch is in "Hand" position OR the combustible gas detector is in alarm condition;
 - a. Damper D-ON1 shall open.
 - b. Damper D-ON-E1 shall open.
 - c. EF-ON1
 - i. The fan shall be energized.
 - ii. The ECM motor shall modulate the fan speed to operate at the design airflow.
 - d. SF-ON1:
 - i. The fan shall be energized and operate at the design airflow.
4. IF the space is unoccupied AND the switch is in "Auto" position;

- a. Damper D-ON1 shall open.
- b. Damper D-ON-E1 shall open.
- c. EF-ON1
 - i. The fan shall be energized.
 - ii. The ECM motor shall modulate the fan speed to operate at 25% of the design airflow.
- d. SF-ON1:
 - i. The fan shall be energized and operate at the design airflow.
- 5. IF the switch is in the "Off" position (for maintenance only);
 - a. Damper D-ON1 shall close.
 - b. Damper D-ON-E1 shall close.
 - c. The fans shall be de-energized.
- 6. Heating:
 - a. IF the outdoor air temperature is less than 50°F (adj) THEN the heating control valve serving HC-ON1 shall modulate as necessary to maintain a discharge air temperature of 55°F (adj).
- 7. If the proof-of-flow switch in either the supply or exhaust air stream indicates a lack of air flow, an alarm and detailed notification shall be sent to the SCADA system alerting the operator to the condition. Refer to the Ventilation Monitoring Horn / Strobe Activation Schedule this Section.
 - a. Maintenance Switch: Provide two position selector switch on door of ATC panel. Label switch "Ventilation Monitoring Alarm" and the positions "Maintenance" and "Active". The switch shall disengage the operation of the horns and strobes when in the "Maintenance" position.
- D. Wet Well Ventilation (EF-ON2):
 - 1. Controlled by the following associated with the ATC panel:
 - a. Hand/Off/Auto switch
 - b. Run cycle timer
 - c. Outside air temperature sensor
 - d. Light status relays (provided by Division 16). Provide wiring to dry contacts; coordinate locations with electrical contractor and electrical plans; refer to ATC riser diagrams for additional information.
 - e. Existing combustible gas detector (provide wiring to detector alarm panel dry contacts; coordinate connection as require to send signal to SCADA system to alert operator to alarm condition)
 - 2. When the lights in the space served are energized, the space shall be considered occupied; when the lights are de-energized, the space shall be considered unoccupied.
 - 3. IF the outside air temperature is greater than 50°F OR the space is occupied OR the combustible gas detector is in alarm condition OR the switch is in "Hand" position;
 - a. Damper D-ON2 shall open.
 - b. The fan shall be energized.
 - 4. IF the outside air temperature is less than 50°F AND the space is unoccupied AND the switch is in "Auto" position, the fan shall be controlled by the run cycle timer on repeating schedule;

AUTOMATIC TEMPERATURE CONTROL (ELECTRONIC)

- a. Active:
 - i. Damper D-ON2 shall open.
 - ii. The fan shall be energized.
 - b. Inactive:
 - i. Damper D-ON2 shall close.
 - ii. The fans shall be de-energized.
 - c. Active - 5 minutes; Inactive - 25 minutes (adj.)
5. IF the switch is in the "Off" position;
- a. Damper D-ON2 shall close.
 - b. The fan shall be de-energized.
- E. Ventilation Monitoring Horn / Strobe Activation Schedule:

Panel	Flow Switch	Horn	Strobe	SCADA notification
ATC-ON1	FSL-ON1	H/S-ON1 H/S-ON2	H/S-ON1 H/S-ON2	Yes
	FSL-ON2	H/S-ON3 H/S-ON4	H/S-ON3 H/S-ON4	Yes

3.2 INSTALLATION

- A. Control wiring shall be neatly installed, parallel to building lines, and in locations not subject to damage. All wiring and conduit to be installed in accordance with the requirements of Division 16.

3.3 IDENTIFICATION

- A. Provide all control equipment, panels and manual controls with black lamacoid nameplates engraved with white letters indicating the function, tag number, service or apparatus being served.
- B. Properly number all wires and terminals where applicable.

3.4 TESTING AND COMPLETION

- A. Initial equipment testing shall be performed in coordination with the work of other trades to confirm system functionality.
- B. Coordinate with Testing and Balancing Contractor to adjust settings as necessary for speed-controlled equipment.
- C. Start-up and operational testing shall be performed in the presence and to the satisfaction of the Engineer's designated representative to demonstrate the function of each system.
- D. Upon completion of the project, the automatic temperature control system provider shall completely adjust, ready for use, all thermostats, controllers, valves, damper operators, relays, etc., provided under this Section.

3.5 OPERATOR TRAINING

- A. Operator Training shall be performed by a duly authorized representative of the ATC system provider, who is fully trained in the installation, startup and operation of the equipment.

- B. Provide combined training and operational assistance for plant operators in the proper operations of the ATC system equipment, and in the techniques, methods, schedules, etc. associated with maintenance.
- C. The level of the training and operational assistance provided shall be as required to ensure proper understanding of the equipment's operations, maintenance and warranty conditions. Should the representative require time in addition to the minimums indicated herein to sufficiently detail the proper operations and maintenance of the equipment, it will be provided at no additional cost to Owner. Under absolutely no circumstances shall warranties become void due to Owner's failure to follow operational and maintenance procedures which were not fully detailed and described in Owner's representatives during these sessions.
- D. At the Owner's discretion, the training sessions may be video recorded for Owner's future use.
- E. The system provider representative shall fill out the Equipment Training Certification form included within this Section. Training will not be considered complete until this form has been provided to the Engineer.

3.6 PROGRAMMED MAINTENANCE

- A. Upon completion of the installation, the automatic temperature control contractor shall submit to the Owner for consideration, an agreement, to provide the necessary programmed maintenance to keep the various control systems in proper working condition.
- B. This proposed programmed maintenance agreement shall fully describe the maintenance work to be performed and shall advise the cost of this work during the 1-year guarantee period provided as part of this Contract by the ATC Contractor as well as for subsequent years thereafter.

3.7 ADJUSTMENTS

- A. The automatic temperature control contractor shall make three (3) follow-up visits during the guarantee period to make adjustments to the system for seasonal variations.

ATC SYSTEM TRAINING CERTIFICATION

Owner: _____ Date: _____

Project: _____

Contractor: _____

ATC System Provider

Representative: _____

Equipment: _____

I, the undersigned System Provider's Authorized Representative, have trained the Owner's personnel listed below in the proper operation and maintenance of the above listed equipment.

(System Provider's Authorized Representative/ Signature & Printed Name)	(Date)
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(Owner's Representative/ Signature & Printed Name)	(Date)
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(Witnessed by Engineer/ Signature & Printed Name)	(Date)
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END OF SECTION

SECTION 15621SEALED COMBUSTION HOT WATER BOILERPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Provide and install, where shown on the Drawings, packaged, modulating, sealed combustion, power-vented, high efficiency gas-fired boilers. Refer to additional requirements in specification Section 15600.
- B. Function of Equipment: The System shall be a forced circulation hot water system with boiler and burner, terminal equipment, circulating pumps, air exhaust system, insulation, temperature controls, and the customary specialties, valves, piping, etc., as specified or required to make a complete installation.

1.2 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: Obtain, at no additional cost to the Owner, all licenses or permits, pay all fees, and comply with all local and state rules and regulations, as well as those of The National Fire Protection Association Sections 54 (National Fuel Gas Code), 30 (Flammable and Combustible Liquids Code), 31 (Installation of Oil Burning Equipment) latest edition.
- B. Verification of Unit Output: Have the boiler and burner manufacturer's representatives supervise start-up including boiler safety relief valve test, combustion efficiency test over full operating range, and carbon dioxide test. Within ten days thereof furnish a written report to the Engineer, providing all test results and confirming that safety and operating controls and burners have been properly installed, calibrated and adjusted.

1.3 SUBMITTALS

- A. Shop Drawings: Submit shop drawings as stated in the General Conditions of the Construction Contract.
- B. Submit complete manufacturer's installation instructions.
- C. Submit all certified reports of verification of unit output test.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver equipment in manufacturer's original unopened protective packaging or skids as job progress requires.
- B. Storage: Store equipment in original protective packaging in a clean and dry environment to keep it clean and free of damage of any nature.
- C. Handle to prevent damage of any nature to the equipment during installation and storage.

1.5 JOB CONDITIONS

- A. Power:
 - 1. Coordinate power wiring with Division 16 contractor.
 - 2. Coordinate control wiring with Division 15 automatic temperature control contractor.

- B. Protection:
1. The Contractor shall be completely responsible for the care and protection of all materials and mechanical work until the project is accepted by the Owner.
 2. Remove all damaged or destroyed materials and equipment from the site and replace in full compliance of the specification at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
1. Lochinvar
 2. Weil McLain
 3. Burnham
 4. Smith
 5. Equivalent product.

2.2 MATERIALS

- A. Boiler size and capacity shall be as shown on the Drawings.
- B. Boiler output shall be minimum net IBR rating.
- C. Boiler: Provide:
1. Minimum 18 gauge steel jacket assembly, primed and pre-painted on both sides.
 2. 316L stainless steel combustion chamber, sealed and completely enclosed, independent of the outer jacket assembly.
 3. Burner/flame observation port.
 4. Burner shall be a premix design and constructed of high temperature stainless steel with a woven metal fiber outer covering to provide modulating firing rates.
 5. Gas valve designed with negative pressure regulation and be equipped with a variable speed blower system.
 6. Leveling legs.
 7. Modulating the firing rate down to 20%
 8. Integrated 24 VAC digital control system and components.
 - a. Capable of controlling a variable speed boiler pump to keep a constant ΔT at all modulation rates.
 - b. Capable of accepting a 0-10 VDC input connection for BMS control of modulation or setpoint.
 - c. Electronic display for boiler set-up, status, and diagnostics.
 - d. Temperature/pressure gauge
 - e. High limit temperature control
 - f. ASME certified pressure relief valve
 - g. Outlet water temperature sensor
 - h. Return water temperature sensor
 - i. UL 353 certified flue temperature sensor
 - j. Outdoor air sensor
 - k. Low water flow protection
 - l. Built-in adjustable freeze protection.
- D. Low voltage connection board with 42 data points for safety and operating controls:

1. Auxiliary Relay
 2. Auxiliary Proving Switch
 3. Alarm Contacts
 4. Runtime Contacts
 5. Manual Reset Low Water Cutoff
 6. Flow Switch
 7. High and Low Gas Pressure Switches
 8. Tank Thermostat
 9. Three Wall Thermostat/Zone Controls
 10. System Supply Sensor
 11. Outdoor Sensor
 12. Building Management System Signal
- E. High voltage terminal strip shall be provided for supply voltage. The high voltage terminal strip plus integral relays provided for independent pump control of the system pump, the boiler pump, and domestic hot water pump.
- F. Boiler shall be suitable for use with propylene glycol, up to 50% concentration without contingencies.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide all piping, electrical, etc., in the boiler room to facilitate the installation of the Boiler-burner Unit.

3.2 PREPARATION

- A. Install boiler and burner in strict accordance with manufacturer's installation instructions, as directed by the Engineer and as shown on the Drawings.
- B. Install the boiler on a 3½-inch high concrete pad.
- C. Provide and install necessary gas train and pressure regulator(s).
- D. Provide and install necessary gas safety shut-offs.
- E. Provide and install fuel filter in fuel piping immediately ahead of burner oil pump.
- F. Provide and install fusible link valve in boiler room fuel supply piping.
- G. Provide and install 16 GA welded steel flue from boiler to chimney.
- H. Provide and install counter balanced backdraft damper in chimney below flue inlet if required by boiler manufacturer.

3.3 INSTALLATION

- A. After the installation is complete, flush and clean the system in accordance with the boiler manufacturer's recommendations. Test the system under normal operating conditions in the presence of the Engineer.

3.4 CLEANING

- A. Upon completion of the installation, remove all of the refuse and surplus materials from the site and leave the building neat and clean.

END OF SECTION

SECTION 15626HVAC SYSTEM PUMPS (IN-LINE CIRCULATORS)PART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Provide and install horizontal inline centrifugal single stage pumps with the capacities and characteristics as shown on the equipment schedules. Refer to additional requirements in specification Section 15600.

1.2 QUALITY ASSURANCE

- A. Verification of Unit Output: Equipment shall be supplied with manufacturer's certificate and pump curve for rated performance, horsepower, etc.

PART 2 - PRODUCTS2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Grundfos.
 - 2. Taco.
 - 3. Bell and Gossett.
 - 4. Equivalent manufacturer.

2.2 MATERIALS

- A. All pump casings shall be centerline discharge of cast iron designed for line mounting. All pumps are to be provided with companion flanges. Units shall have a maximum operating pressure of 175psig at a maximum operating temperature of 300° F.
- B. Pumps shall have a cast bronze impeller and shall be dynamically balanced. Suction and discharge flanges shall be provided with drilled and tapped gauge ports.
- C. Pump shall be canned-rotor type, the pump and motor form an integral unit without shaft seal and with only two gaskets for sealing. The bearings are lubricated by the pumped liquid.
- D. Controller shall be integrated in the control box.
- E. Pump shall contain built-in differential-pressure and temperature sensor.
- F. Rotor can shall be made of carbon-fiber-reinforced composite.
- G. Stainless-steel bearing plate and rotor cladding.
- H. Aluminum alloy stator housing.
- I. Air-cooled power electronics.

PART 3 - EXECUTION3.1 INSTALLATION

- A. Install using manufacturer's recommendations and as shown on the Drawings.
- B. Install so no vibration is transmitted to piping system. Provide independent support and flexible connections as required to eliminate pipeline vibration.
- C. Fully lubricate pump in accordance with manufacturer's recommendations prior to

start-up.

3.2 ADJUSTING

- A. Test and run complete heating system under actual working conditions and adjust the unit to the satisfaction of the Engineer.

END OF SECTION

SECTION 15680

DEHUMIDIFIERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish and install dehumidifiers as shown on the Drawings and as specified. Refer to additional requirements in specification Section 15600.
- B. Other Trades: Cooperate with other trades whose work is to be coordinated with Dehumidifiers.

1.2 QUALITY ASSURANCE

- A. Standards and Codes:
 - 1. Underwriters' Laboratories, Inc.
 - 2. National Electric Code.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit shop drawings, manufacturer's literature, maintenance data and operating instructions as specified in Section 01340 and the General Conditions of the Construction Contract.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in manufacturer's unopened containers as job progress requires.
- B. Storage: Store in unopened containers in a weathertight building.
- C. Handling: Exercise care when handling dehumidifiers to prevent damage of any nature.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Quest.
 - 2. Santa Fe.
 - 3. Dri-Eaz.
 - 4. Airrex.
 - 5. Equivalent manufacturer.

2.2 MATERIALS

- A. Dehumidifiers:
 - 1. The dehumidifiers shall be self-contained, electrically operated, residential/commercial type consisting of a sealed refrigerating unit with condenser coil, evaporator coil, blower assembly and integral humidistat.
 - 2. All parts shall be securely mounted in a steel cabinet.
 - 3. The cabinet shall be provided with a tapped drain connection.
 - 4. Size, capacity, and electrical characteristics as indicated on the drawings.

5. Dehumidifiers shall be fully automatic and complete with all necessary controls including integral control panel and control relays all prewired at the factory.
6. Dehumidifiers shall be controlled automatically by a built-in adjustable unit mounted humidistat to start and stop the compressor.
7. Controls and wiring shall be in accordance with the requirements specified under the applicable electrical sections.

2.3 SPARE PARTS

- A. Provide one set of manufacturer's recommended spare parts for future use by the Owner:
 1. Air filters.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install using manufacturer's recommendations and as shown on the Drawings.

3.2 ADJUSTING AND CLEANING

- A. Adjust operation and clean to the satisfaction of the Engineer.

END OF SECTION

SECTION 15750

HOT WATER COILS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Provide and install hot water heating coils of the types, sizes and capacities shown on the drawings. Refer to additional requirements in specification Section 15600.

1.2 QUALITY ASSURANCE

- A. Verification of Operating Data: Capacities, pressure drops and selection procedures shall be certified in accordance with ARI Standard 410.
- B. Tests: All coils shall be proof tested at 1.5 times maximum working pressure, then leak tested at maximum working pressure. Minimum test pressures are 300psig proof test and 200psig leak test.

1.3 SUBMITTALS TO THE ENGINEER

- A. Shop Drawings shall be submitted as required by the general conditions. Shop drawings shall consist of, but not be limited to, the following:
 - 1. Manufacturer's certificate of operating data for each coil.
 - 2. Dimensional data for each coil.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. USA Coil
 - 2. Durham-Bush
 - 3. McQuay, Inc.
 - 4. Trane Company
 - 5. Equivalent manufacturer

2.2 MATERIALS

- A. Tubes - Round 5/8-inch or 1-inch OD copper or red brass tubes expanded into full fin collars for permanent fin-tube bond and expanded into cast iron headers (headers 33-inches or less) for permanent leak-tight joint.
- B. Fins - Configured, plate-type aluminum or copper fins with full fin collars for maximum fin-tube contact and accurate spacing, mechanically bonded to tubes for permanent fin-tube bond.
- C. Casings - 16-gauge galvanized steel casings, center and end supports are provided.
- D. Headers - Gray cast iron (finely dispersed graphite, peralitic) for 12 through 33-inch header heights.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in strict accordance with the manufacturer's instructions and recommendations and as shown on drawings.
- B. Install with shut off valves, control valves, balancing valves, air vents and duct transitions as required for unit operation and balancing.

END OF SECTION

SECTION 15760HOT WATER UNIT HEATERSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Provide and install unit heaters of the types and sizes shown on the Drawings. Refer to additional requirements in specification Section 15600.

1.2 QUALITY ASSURANCE

- A. Verification of Capacities: Supply manufacturer's certificate of output for the unit heaters.

1.3 SUBMITTALS

- A. General: Submittals shall be in accordance with specification Section 01340.
- B. Submittals shall show physical dimensions, electrical data and performance output. Where there is a requirement for explosion proof motor the shop drawing will verify that the motor and associated wiring devices meet Class I, Group D, Division I requirements.

PART 2 - PRODUCTS2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Vulcan Radiator
 - 2. Trane
 - 3. Modine
 - 4. Equivalent manufacturer.

2.2 MATERIALS

- A. Unit capacity and type shall be as shown in the equipment schedule on the Drawings.
- B. Casing: Heavy gauge steel with electrostatically applied finish with manufacturers standard color unless otherwise noted.
- C. Coil: Copper tubing mechanically bonded to aluminum fins.
- D. Fan and Motor:
 - 1. Unit shall have a direct-mounted aluminum propeller fan.
 - 2. Electrical characteristics as indicated.
 - 3. Motors shall be Totally Enclosed Non-Ventilated (TENV) type with integral thermal overload protection unless unit heater is located in a Class I, Division II, Group D space which will require an explosion proof motor, including wiring devices.
 - 4. Operated by a zone thermostat (fan cycling).
 - 5. Shall have vibration proof mountings and be permanently lubricated with provisions for field lubrication.
- E. Provide individually adjustable horizontal louvers on horizontal discharge units.
- F. Provide casings with special corrosion resistant coatings as shown on the Drawings.

Coatings shall give superior resistance to corrosion due to high moisture levels and shall be equivalent to air dried epoxy phenolic or baked phenolic finishes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in strict accordance with the manufacturer's instructions and recommendations and as shown on the Drawings.
- B. Install with shut off valves, balancing valves, and air vent as required for unit operation and balancing.
- C. Performance testing and balancing shall be in accordance with specification Section 15907-Testing and Balancing Heating and Ventilating Systems.
- D. Unit heater hangers shall be fabricated and installed so as to prevent unit vibration and/or movement during normal operation cycle. Hot water supply and return piping shall not be supported by the unit heater.

END OF SECTION

SECTION 15820

VENTILATION FANS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Provide and install ventilation fans of the types and arrangement as shown on the Drawings and as specified herein. Refer to additional requirements in specification Section 15600.

1.2 QUALITY ASSURANCE

- A. Standards
 - 1. Air Movement and Control Association
AMCA 210-85 Laboratory Methods of Testing Fans for Rating
AMCA 300-85 Test Code for Sound Rating
 - 2. National Fire Protection Association
NFPA 70-90 National Electrical Code
NFPA 90A Installation of Air Conditioning and Ventilating Systems
- B. Each fan shall be licensed by AMCA to bear the Certified Rating Seal. When this standard is not applicable, the manufacturer shall submit data to verify the fan capacity at the specified operating condition.

1.3 SUBMITTALS

- A. General: Submittals shall be in accordance with specification Section 01340.
- B. Submittals shall show physical dimensions, shaft sizes, drives, drive arrangement, motor data, electrical data and performance curves. Where there is a requirement for explosion proof motor the shop drawing will verify that the motor and associated wiring devices meet Class I, Group D, Division I requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers
 - 1. Greenheck.
 - 2. Loren Cook.
 - 3. Twin City Fan.
 - 4. Equivalent manufacturer.

2.2 MATERIALS

- A. General: Refer to the Drawings for the following information (when applicable):
 - 1. Specific type and size of fan.
 - 2. Electrical characteristics - voltage and phase.
 - 3. Direct or belt drive.
 - 4. Requirement for explosion proof motors including wiring devices (Class I, Group D, Division 1).

5. Requirements of explosion proof fan construction shall comply with AMCA Standards handbook Publication 99-86, construction type "B".
 6. Special corrosion resistant coatings.
 7. Additional accessories and specialties.
- B. Motors:
1. Totally enclosed fan cooled (TEFC) unless noted otherwise.
 2. Integral thermal overload protection on single phase fractional horsepower motors
 3. Motors driven by Variable Frequency Drive units shall be rated for VFD operation.
 4. ECM motors shall be DC electronic commutation type motor (ECM) specifically designed for fan applications. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
- C. Belt Drive Units:
1. Shaft seals (axial & vane axial).
 2. Belt guard (full belt enclosure).
 3. Motor cover (weatherproof for exterior mounted fans and fans in wet areas).
 4. Variable pitch sheave on motor.
 5. Idler wheel when required for belt adjustment.
 6. Adjustable motor base when required for belt adjustment.
- D. Inline Centrifugal Fans:
1. Duct mounted, belt or direct driven as scheduled.
 2. Fan wheels, aluminum backward inclined.
 3. Housing, all aluminum construction.
 4. Mounting brackets and vibration isolations required for wall mounting or hanging from ceiling as shown.
 5. AMCA certified for both air and sound performance.
 6. Completely wired internally with leads brought to an external junction box.
 7. Belt drive fans shall have variable pitch sheaves selected with scheduled operating point midrange of the selected sheave.
- E. Mixed Flow Inline Fans:
1. Duct mounted, belt or direct driven as scheduled.
 2. Housing:
 - a. Tubular fan housing, completely welded and coated with finish as noted on Drawings. No uncoated steel parts will be allowed.
 - b. Housing and bearing support constructed of welded structural steel members.
 - c. Discharge vanes.
 - d. Access door.
 - e. OSHA compliant belt guard and motor cover.
 3. Mounting brackets and vibration isolations required for wall mounting or hanging from ceiling as shown.

4. Mixed flow impeller, electronically balanced to ANSI S2.19 G6.3, contoured blade profiles, mill finish aluminum.
5. AMCA certified for both air and sound performance.
6. Completely wired internally with leads brought to an external junction box.
7. Belt drive fans shall have variable pitch sheaves selected with scheduled operating point midrange of the selected sheave.

2.3 SPARE PARTS

- A. Provide one set of manufacturer's recommended spare parts for future use by the Owner:
 1. Fan belts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as required in strict accordance with the manufacturer's instructions and recommendations and as shown on the Drawings.
- B. Provide flexible duct connections on inlet and outlet of fan when fans are ducted.
- C. Install fans on roof or exterior wall with flashing to prevent water and weather from entering building.
- D. Performance testing and balancing shall be in accordance with specification Section 15907-Testing and Balancing Heating and Ventilating Systems.

END OF SECTION

SECTION 15840

DUCTWORK AND DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Provide and install all required sheet metal and ductwork, setting of control dampers, louvers, flexible connections, and devices as shown on the drawings or required to make the installation complete in accordance with the intent of the drawings and specifications. Refer to additional requirements in specification Section 15600.
- B. Design Criteria: The drawings do not show every detail of fittings, hangers and equipment which are necessary for the complete installation but are provided to show the general arrangement.

1.2 QUALITY ASSURANCE

- A. Ductwork:
 - 1. SMACNA "HVAC Duct Construction Standards - Metal & Flexible".
 - 2. ASHRAE Duct Construction Recommendations (5 percent maximum leakage allowable).
 - 3. SMACNA "Round Industrial Duct Construction Standards".

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit manufacturer's certification for the type of material provided.
- B. Submit all shop drawings to the Engineer as specified in the General Conditions of the Construction Contract and as specified in Section 01340.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver all ductwork and accessories as Work progress requires.
- B. Store all material to prevent damage of any nature.

1.5 JOB CONDITIONS

- A. Protection:
 - 1. Protect all ductwork, and accessories from the accumulation of paint, concrete, mortar, etc.
 - 2. Keep the interior of duct system free from dirt, rubbish, etc.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Ducts, devices and accessories shall be constructed of materials as noted below and on the Drawings.
 - 1. Aluminum 3003 alloy H14 temper per ASTM B209. Select ductwork and reinforcement to meet SMACNA standards in aluminum duct to achieve a ($\pm$) 4" w.c. pressure rating.
- B. All longitudinal and traverse joints, seams and connections of supply and return

ducts operating at a static pressure less than or equal to 2 inches water gauge (w.g.) shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic plus embedded fabric systems or tapes installed in accordance with the manufacturers installation instructions.

- C. Sealant and Gaskets
 - 1. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 - 2. Water-Based Joint and Seam Sealant:
 - a. Application Method: Brush on.
 - b. Solids Content: Minimum 65 percent.
 - c. Shore A Hardness: Minimum 20.
 - d. Water resistant.
 - e. Mold and mildew resistant.
 - f. VOC: Maximum 75 g/L (less water).
 - g. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - h. Service: Indoor or outdoor.
 - i. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
 - j. Color: White, to match supply ductwork.
 - 3. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- D. Insulation: Ducts requiring insulation shall use materials specified in Section 15891. Note that duct sizes shown are inside clear dimension, not necessarily sheet metal size.
- E. Diffusers, grilles, and registers:
 - 1. All air devices shall be supplied by a single manufacturer.
 - 2. Acceptable manufacturers:
 - a. Price.
 - b. Nailor.
 - c. Titus
 - d. Anemostat.
 - e. Manufacturers with equivalent diffusion pattern, air throw, velocity, and sound level.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Elbows, vaned elbows, take-offs, branch connections, transitions, splitters, duct volume dampers, fire dampers, flexible connectors, and access doors shall conform to SMACNA Duct Construction Standards.
- B. Install duct so that ductwork shall operate without chatter, vibration, and be air tight so that no dust marks from air leaks will show at connections or outlets.
- C. Field Changes to Ductwork: Design changes such as those required to suit the size of factory fabricated equipment actually furnished to minimize losses in pressure and performance due to sudden expansion and contraction. Use transitions in field

changes as well as modifications to connecting ducts.

- D. **Splitters and Dampers:** Dampers shall have accessible operating mechanism, and where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Splitter dampers shall be operated by quadrant operators or 3/16-inch rod brought through the side of the duct with locking setscrew and bushing. Two rods are required on splitters over 8 inches. Manual volume-control dampers shall be operated by locking type quadrant operators. Dampers and splitters shall be two gages heavier than duct in which installed. Unless otherwise indicated, multi-leaf damper shall be opposed blade type with maximum blade width of 4 inches. Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, provide the locking type quadrant operators for dampers, when installed on ducts to be thermally insulated, with stand-off mounting brackets, bases or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Provide volume dampers where shown on the Drawings.
- E. **Air Deflectors:** Provide air deflectors in all square elbows, duct- mounted supply outlets, takeoff or extension collars to supply outlets, and tap-in branch-takeoff connections. Air deflectors shall be factory-fabricated and factory- or field-assembled units consisting of curved turning vanes or louver blades for uniform air distribution and change of direction with minimum turbulence and pressure loss. Provide square elbows with curved vanes as shown on the Drawings. Devices shall be of the same material as ductwork.
- F. **Duct Access Doors:** Provide hinged doors at all automatic dampers, fire dampers, coils, thermostats, temperature controllers, and other apparatus requiring service and inspection in the duct system. Doors shall be 12 by 12 inches unless otherwise shown on the Drawings. Where size of duct will not accommodate this size, make the doors as large as practical. Install doors not less than 24 by 24 inches on each side of each air-handling unit. Doors shall be rigid, and shall be provided with airtight felt gaskets. Provide doors with hinges, pins and two fasteners of the same material as the adjacent duct. Provide doors 24 by 24 inches or larger with fasteners operable from both sides. Doors in insulated ducts shall be of the insulated type. Unless otherwise shown on the Drawings, doors shall swing so that fan pressure or suction holds the door closed.
- G. **Duct Sleeves and Prepared Openings:**
 - 1. **Round ducts - 15 inches in diameter or less:** Provide duct sleeves for all round ducts 15 inches diameter or less passing through floors, walls, ceiling, or roof. Install ducts larger than 15 inches diameter and all square and rectangular ducts passing through floors, walls, ceilings or roof. Sleeves shall conform to the requirements of Section 15092 except as noted below:
 - a. Sleeve shall provide one-inch clearance between the duct and the sleeve, or one inch clearance between the insulation and the sleeve for insulated ducts, except at grilles, registers, and diffusers.
 - 2. **Round ducts larger than 15 inches diameter and all rectangular ducts:**

- a. Install ducts larger than 15 inches diameter and all square and rectangular ducts passing through floors, walls, ceilings or roof through prepared openings.
 - b. Provide one-inch clearance between the duct and the prepared opening, or one-inch clearance between the insulation and the prepared opening for insulated ducts, except at grilles, registers, and diffusers.
 - c. Space between the prepared opening and the duct or duct insulation shall be packed with commercial grade twisted fireproof yarn. Seal the annular space with polyurethane sealant, S-6, per Section 07900 for standard penetrations. Penetrations through fire rated walls and floors shall utilize Fyre-shield sealant, S-7, per Section 07900 in lieu of the polyurethane sealant.
3. The contractor shall be responsible for the proper size and location of sleeves and prepared openings. The Drawings attempt to indicate approximate sleeve and prepared opening sizes. The actual size is to be carefully coordinated with concrete placement and other construction activities to ensure sufficient and properly sized sleeves and prepared openings are provided. Due consideration should be given to the need for increased opening sizes to accommodate devices such as fire dampers or contractor selected equipment.
 4. Provide duct sleeves and prepared openings for all duct mains and duct branches. Branch takeoff connections to grilles, registers, and diffusers shall be in accordance with SMACNA HVAC Duct Construction Standards - Metal & Flexible.
- H. Duct Supports: Provide and install duct supports not less than two 1-inch by 1/16-inch thick spaced one on each side of duct in accordance with SMACNA HVAC Duct Construction Standards Metal & Flexible. Supports on the risers shall allow free vertical movement of the duct.
- I. Support ducts and install to be completely free from vibration under all conditions of operation. Attach supports only to structural framing member and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, use retainer clips.
- J. Access Panels: Provide access panels for all concealed valves, controls, dampers, duct access doors, and any item requiring inspection and maintenance. Provide access panels of sufficient size.
- K. Air Filters: Install air filters so that access space for servicing the filters is provided. Install filters with suitable sealing to prevent bypassing of air.
- L. Flexible Collars: Provide flexible collars in connections between fans and ducts or casings and where ducts are of dissimilar metals, as shown on the Drawings and were required. Make collars of neoprene coated glass fabric weighing approximately 30 ounces per square yard. Securely fasten flexible connections by stainless steel clinch type bands for round ducts. For rectangular ducts, install the flexible connections locked to metal collars using normal duct construction standards.
- M. Flashings: Where ducts pass through exterior building walls and roofs, provide

flashings and make waterproof. Flashing shall conform to Division 7.

- N. Cleaning of Duct System: After completing installation of ductwork, clean the entire system of rubbish, plaster, dirt and any other debris. After installation of equipment and connections are made to fan, and before any grilles, outlets or registers are installed, blow out the entire system with dampers and outlets wide open.

3.2 QUALITY CONTROL

- A. Tests: Upon completion and prior to acceptance of the installation, perform the following tests:
 - 1. Low Pressure/Velocity Ductwork: Make all supply ducts, return ducts, exhaust ducts, plenums, and casings substantially airtight in compliance with SMACNA Duct Class C criteria. Inspect duct joints for completeness of seal under operation at the indicated system pressure before covering with insulation or concealing in masonry. Substantially airtight shall be construed to mean that no air leakage is noticeable through the senses of feeling or hearing at all duct joints.
- B. Preliminary Tests: Give the air supply and distribution system and its components an operational test for a period of not less than 4 hours.
- C. After preliminary test, adjust, test and balance the air supply and distribution system to obtain air volumes as shown on the Drawings. Record final balanced air quantities and submit to the Engineer for approval.
- D. Provide necessary samples from installed ductwork as Engineer may require (not to exceed 10) for inspection purposes. Patch all openings due to the removal of the samples at no additional cost to the Owner.

3.3 SHEET METAL THICKNESS TABLES

- A. Minimum Sheet Metal Gauges for Rectangular Duct for both galvanized steel and stainless steel ducts shall be according to SMACNA HVAC Duct Construction Standards.
- B. Wherever the tables allow for more than one choice of gage and reinforcement, the Contractor shall select the gage reinforcement and reinforcement spacing that will be used throughout the Contract and submit this information to the Engineer through the submittal process specified in the General Conditions.

END OF SECTION

SECTION 15862

DAMPERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Provide and install dampers and accessories where shown on the Drawings. Refer to additional requirements in specification Section 15600.

1.2 SUBMITTALS TO THE ENGINEER

- A. Submit shop drawings in accordance with the General Conditions of the Construction Contract.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver as Work progress requires.
- B. Protect in a suitable weathertight enclosure to prevent damage of any nature.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Greenheck
 - 2. Air Balance, Inc.
 - 3. Ruskin.
 - 4. Or approved equal.

2.2 MATERIALS

- A. Manual Volume Dampers
 - 1. Standard Rectangular Dampers:
 - a. Greenheck VCD-43 volume damper or equivalent product.
 - b. Multi-blade aluminum, parallel or opposed blade as indicated.
 - c. Manual locking quadrant.
 - 2. Standard Round Dampers:
 - a. Greenheck VCDR-50 volume damper or equivalent product.
 - b. Type 304 stainless steel, round blade as indicated.
 - c. Manual locking quadrant.
- B. Motor Operated Air Control Dampers:
 - 1. Control Dampers:
 - a. Equal to Greenheck VCD-43 control damper.
 - b. Multi-blade, parallel or opposed blade as indicated.
 - c. Fully gasketed with a maximum allowable leakage of 4 cfm per square foot of face area at 1 inches W.C. differential pressure.
 - d. Entire damper shall be constructed from aluminum 6063-T5 structural shapes and extrusions.
 - e. Bearings and blade shafts shall be non-corrosive.
- C. Damper Operators:

1. Manual operators supplied by damper or louver manufacturer.
 2. Motor operators and linkage to connect motor to damper linkage will be furnished and installed by the Automatic Temperature Control (ATC) Contractor.
 3. Normal closed or open as noted, spring return, electric motor operated. Modulating type as indicated in Section 15604.
 4. Damper operators shall match the NEMA classification of the space in which they are installed.
- D. Miscellaneous Connecting Sheet Metal:
1. Galvanized steel or stainless steel to match adjacent duct.
 2. Thickness: Per SMACNA
 3. Joints, seams, connections, cross bracing, flanges and supports as required for installation and recommended by SMACNA.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install dampers, operators and linkage in strict accordance with the manufacturer's instructions and recommendations.
- B. Ensure all blades open, close, and seal properly.
- C. Adjust weights on backdraft dampers.

END OF SECTION

SECTION 15869

LOUVERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Provide and install louvers and accessories where shown on the Drawings. Refer to additional requirements in specification Section 15600.

1.2 QUALITY ASSURANCE

- A. All louvers shall be certified by AMCA for air pressure drop, free area, and water penetration.
- B. Acceptable Manufacturers:
 - 1. Ruskin Mfr. Co.
 - 2. Air Balance, Inc.
 - 3. Louvers & Dampers, Inc.
 - 4. American Warming and Ventilating, Inc.
 - 5. Airstream Inc.
 - 6. Or equivalent.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit shop drawings, manufacturer's literature, maintenance data and operating instructions as stated in the General Conditions of the Construction Contract.
- B. Submit free area, pressure drop, and water penetration data for each louver for approval.
- C. Submit AMCA certification for louver style.
- D. Submit sample louver section with proposed finish for review and no exceptions taken by the Engineer.
- E. Submit scale drawings of each louver showing sizes, construction details, and mullion locations.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver in manufacturer's unopened containers as job progress requires.
- B. Store in unopened containers in weathertight building.
- C. Exercise care in handling to avoid bending blades or frames, damaging finish and other damage of any nature.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Acceptable Manufacturers:
 - 1. Greenheck
 - 2. Ruskin Mfr. Co.
 - 3. Air Balance, Inc.
 - 4. Louvers & Dampers, Inc.
 - 5. Equivalent manufacturer.

- B. Exterior Stationary Louvers:
1. Equal to Greenheck model EDJ-601.
 2. Storm proof, .081 extruded aluminum 6063-T5 blades.
 3. Architectural style.
 4. 6063-T5 extruded structural aluminum frame, .100" wall thickness, mitered corners, and caulking slots.
 5. Rigid hidden architectural style mullions as required for span, but not greater than 48" on center. Provide mullions at each section of louver requiring duct or fan connection.
 6. Blade stiffeners.
 7. 1/2-inch mesh replaceable aluminum bird screen on interior, insect screen where shown on the Drawings.
 8. Kynar 500 finish - manufacturer's standard color selected by Engineer.
 9. 6-inch depth.
 10. Provide extended sill.
 11. Caulk slots and flange when installed in masonry construction. Provide nailing flange when installed in wood frame construction.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as required using manufacturer's instructions and recommendations and as shown on the Drawings.
- B. Caulk all openings as required in Division 7 and as shown on the Drawings.
- C. Isolate metal to metal contact between aluminum louver frames and steel damper frames or ductwork with suitable paint.

3.2 CLEANING AND ADJUSTING

- A. Clean all louvers and dampers of grease, tar and dirt to the satisfaction of the Engineer.
- B. Adjust all louvers to the satisfaction of the Engineer.

END OF SECTION

SECTION 15891DUCT INSULATIONPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Provide and install all duct insulation as shown on the Drawings and specified herein. Refer to additional requirements in specification Section 15600.

1.2 QUALITY ASSURANCE

- A. Fire Hazard Rating: When tested by ASTM E84 method flame spread rating shall not exceed 25.
- B. Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold, or provide certification or validation by other third-party programs that products meet the requirements of this Section.
- C. Qualified installers shall have successfully completed three or more similar type jobs within the last five years.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit samples of each insulation type.
- B. Submit 2'-0" piece of sealing tape.

PART 2 - PRODUCTS2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Closed cellular flexible plastic:
 - a. Armacell "AP/ARMAFLEX".
 - b. Aeroflex.
 - c. Equivalent manufacturer.
 - 2. Fiberglass:
 - a. Owens-Corning.
 - b. Knauf.
 - c. Certainteed.
 - d. Equivalent manufacturer.

2.2 MATERIALS

- A. Duct insulation for wet area locations:
 - 1. Closed cellular flexible plastic:
 - a. One inch thick
 - b. Thermal conductivity @ 75°F: 0.27/BTU-in/hr-ft²-°F maximum
 - c. UL flame spread: 25 or less
 - d. Equal to Armacell AP/ARMAFLEX
 - 2. Designated wet areas as follows:

- a. Wet well.
- B. Duct insulation for non-wet area locations:
 - 1. Ductwork:
 - a. 1½ inch thick fiberglass ductwrap
 - b. Factory applied reinforced aluminum or vinyl vapor barrier facing.
 - c. Thermal conductivity @ 75°F: 0.26/BTU-in/hr-ft²-°F maximum
 - d. Equal to Owens-Corning series ED-100 FRK-25

PART 3 - EXECUTION

3.1 APPLICATION

- A. Duct Insulation:
 - 1. Required on all outside air intakes from exterior wall or roof to duct termination including fan casing.
 - 2. Required on all heated or cooled supply air ductwork from air handling unit to duct termination including air handler if not factory insulated.
 - 3. Required on exhaust ductwork from outside closure damper to exterior wall or roof.
 - 4. Insulate entire ducts and seal to prevent condensation on cold surfaces, including standing seams, support straps, and other metal attached to the ductwork.
 - 5. Insulate access doors and gaskets to prevent metal to metal contact.
- B. Apply insulation to clean, dry ductwork.
- C. Remove damaged insulation and replace to the satisfaction of the Engineer at no additional cost to the Owner.
- D. Use sealing tapes 3 inches wide, reinforced, pressure sensitive type, SMACNA approved. Tapes that do not adhere to insulation shall be cause for rejection of all insulation work. Only apply tape when ambient temperature is between 40°F and 100°F.
- E. Closed cellular plastic:
 - 1. Obtain adhesive from the insulation manufacturer and apply to entire duct surface, and all joints.
 - 2. Apply in strict accordance with manufacturer's instructions and recommendations.
- F. Fiberglass Ductwrap:
 - 1. Apply insulation adhesive in 4" wide strips, 8" on center, circumferentially around duct.
 - 2. Tightly wrap insulation around duct with all joints butted and longitudinal joint overlapped 2 inches.
 - 3. On the bottom of ductwork over 24 inches wide, provide and install mechanical fasteners at not more than 18" on center.
 - 4. Tape all joints with 3" wide tape.
 - 5. Tape over protruding stick pins.

END OF SECTION

SECTION 15907TESTING AND BALANCING HEATING AND VENTILATING SYSTEMSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: The testing and balancing Work includes the measurement and setting of air and water flow devices in accordance with the Contract Documents for the systems, recording data, making tests, and preparing reports, all as hereinafter specified. Perform the Work specified in this Section on, and after the completion of, Work on the HVAC systems. Refer to additional requirements in specification Section 15600.
- B. Qualifications: Obtain the services of a qualified testing organization, approved by the Engineer, to perform the testing and balancing work as herein specified. The criteria for determining qualifications of the testing organization shall be certification by the Associated Air Balance Council (AABC), certification by the National Environmental Balancing Bureau (NEBB), or organization shall have submitted proof to satisfy the Engineer that the organization meets the technical standards for membership of the AABC as published in the AABC "National Standards for Field Measurements and Instrumentation - Total System Balance", Volume Two, No. 12173, except that affiliation with manufacturers, installing contractors, or engineering firms may not preclude their acceptance.
- C. Procedures: Accomplish the Work in accordance with the Agenda specified herein. Follow procedures described herein and, in general, if not specifically described herein, the Work shall be in accordance with the Associated Air Balance Council's "National Standards for Field Measurements and Instrumentation Total System Balance", Volume Two, No. 12173, and standards of NEBB.
- D. Cooperate with the selected test and balance agency in the following manner:
 - 1. Provide sufficient time before final completion date so that tests and balancing can be accomplished.
 - 2. Provide immediate labor and tools to make corrections when required without undue delay. Install balancing dampers as required by test and balance agency.
 - 3. Put all heating, ventilating and air conditioning systems and equipment into full operation and continue the operation of same during each working day of testing and balancing.
 - 4. Keep the testing and balancing agency informed of any major changes made to the system during construction and provide with a complete set of as-built drawings.
 - 5. Include the costs of dampers, pulley and belt changes and the costs of obtaining the test and balancing agency in the Contract price.
- E. Installation shall not be considered complete until final reports by the testing agency have been submitted to the Engineer and approved.

1.2 SUBMITTALS TO THE ENGINEER

- A. Submit the name of the proposed testing organization to the Engineer for approval within 90 days after Contract award.
- B. Provide all results of all required tests for the Engineer's approval.

1.3 AGENDA

- A. Preliminary Report: Review Drawings and Specifications prior to the installation of any of the affected systems and submit a written report to the Engineer indicating any deficiencies in the system that would preclude the proper adjusting, balancing, and testing of the systems.
- B. Submit an agenda for approval by the Engineer prior to start of testing and balancing work. The agenda shall include the following:
 - 1. A complete listing of all air and water flow and air terminal measurements to be performed.
 - 2. Specific test procedures and parameters for determining specified quantities, e.g., flow, drafts, etc., from the actual field measurements to establish compliance with the Contract Documents.
 - 3. Samples of forms showing applications of procedures and calculations to typical systems.
- C. Advise the Engineer in advance when the testing will begin so that the testing procedure and techniques can be evaluated and approved or modified.
- D. Procedure Reporting: Specific test procedures for measuring air quantities at terminals shall specify type of instrument to be used, method of instrument application (by sketch), and factors used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Not applicable in this Section.

PART 3 - EXECUTION

3.1 PROCEDURES AND INSTRUMENTS - GENERAL

- A. Requirements: Adjust all systems and components to perform as required by the Drawings and Specifications.
- B. Test Duration: Perform operating tests of heating coils, fans and other equipment no less than a four-hour duration after stabilized operating conditions have been established. Base capacities on temperatures and air and water quantities measured during such tests.
- C. Instrumentation: Use methods of application of instrumentation in accordance with the approved agenda.
- D. Use only instruments used for measurements that are accurate, and calibrated within 6 months of the testing with calibration histories for each instrument available for examination. Have each test instrument calibrated by a laboratory approved by the Engineer or by the manufacturer. The Engineer has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.

TESTING AND BALANCING HEATING AND VENTILATING SYSTEMS

- E. Apply all instruments in accordance with manufacturer's instructions and recommendations.
- F. Provide all labor, instruments and appliances required. Do not install instruments that are permanent installations used for the tests, e.g., gages, thermometers, etc., until just prior to the tests to avoid damage and changes in calibration.
- G. Accuracy of all thermometers shall be plus or minus 1 graduation at the temperatures to be measured. Graduations shall conform to the following schedule.

<u>Medium</u>	<u>Design Temperature Differential (°F)</u>	<u>Maximum Graduation (°F)</u>
Air	10 or less	1/2
Air	over 10	1
Water	10 or less	1/10
Water	10-20	1/2
Water	over 20	1

3.2 AIR SYSTEM PROCEDURES

- A. Adjustments: Adjust all air handling systems to provide the required design air quantity to, or through, each component. Conduct adjustment and balancing of all systems during the period of the year approximating maximum seasonal operation, unless otherwise directed or approved by the Engineer.
- B. Equalizers: Adjust equalizing devices to provide uniform velocity across the inlets (duct side for supply) of terminals prior to measuring flow rates.
- C. Balance: Use flow adjusting (volume control) devices to balance air quantities only, i.e., proportion flow between various terminals comprising system, and only to the extent that their adjustments do not create objectionable air motion or sound, i.e., in excess of normal limits.
- D. Accomplish balancing between runs (submains, branch mains and branches) generally by flow regulating devices at, or in, the divided flow fitting.
- E. Restriction imposed by flow regulating devices in or at terminals shall be minimal. Make final measurements of air quantity after the air terminal has been adjusted to provide the optimum air patterns of diffusion.
- F. Fan Adjustment: Generally vary the total air system quantities, by adjusting fan speeds, or axial-flow fan wheel blade pitch. Use damper restriction of a system's total flow only for systems with direct connected fans (without adjustable pitch blades), provided system pressure is less than 1/2 inch w.g.
- G. Except as specified herein, make pitot tube traverses of each duct to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform to the ASHRAE Handbook of Fundamentals.
- H. Omit pitot tubes traverse when the duct serves only a single room of space and its design volume is less than 200 cfm. In lieu of Pitot tube traverse, determine air flow in the duct by totaling volume of individual terminals served, measured as specified herein.
- I. Where duct's design velocity and air quantity are both less than 1000 (fpm/cfm), determine air quantity by measurements at terminals served.
- J. Test Holes: Provide test holes, in straight ducts, as far as possible downstream from

elbows, bends, take-offs, and other turbulence generating devices, to optimize reliability of flow measurements.

- K. Air Terminal Balancing.
- L. Air Motion: Air motion and distribution shall be as specified and as shown on Drawings. In addition to air motion measurements, make smoke tests wherever requested by the Engineer, to demonstrate the air distribution from air terminals, at no additional cost to the Owner.
- M. Changes in the specified agenda due to field conditions, will be considered for approval by the Engineer.

3.3 WATER SYSTEM PROCEDURES

- A. Adjustment: Adjust all heating, bypass, and transfer systems to provide the required quantity to, or through each component.
- B. Metering: Measure water quantities and pressures with calibrated meters.
- C. Use venturi tubes, orifices, or other metering fittings installed in system and pressure gages to measure water flow rates and balance the systems.
- D. Adjust the systems to provide the approved pressure drops through the heat transfer equipment (coils, converters, etc.) prior to the capacity testing.
- E. Where flow metering fittings are not installed, determine flow balance by measuring temperature differential across the heater transfer equipment.
- F. Perform measurement of temperature differential with the air system, adjusted as described herein, in operation.
- G. Automatic Controls: Position automatic control valves for full flow through the heat transfer equipment of the system during tests.
- H. Flow: Adjust the flow through bypass circuits at three-way valves to balance that through the supply circuit.
- I. Distribution: Adjust distribution by balancing devices (cocks, valves, and fittings) and automatic flow control valves as provided. Do not use service valves.
- J. Only record pressure differential where automatic flow control valves are utilized in lieu of venturi tubes, provided the pressure is at least the minimum applicable to the tag rating.
- K. Special Procedures: Where available pump capacity (as designed) is less than total flow requirements of individual heat transfer units of system served, full flow may be simulated by the temporary restriction of flow to portions of the system; specific procedures shall be delineated in the agenda.

3.4 TEST RECORDS

- A. Submittal: Submit three (3) copies of the reports described herein, covering air and water system performance, and air motion (fpm), to the Engineer prior to final tests and inspection.
- B. Instrument Records: Include types, serial numbers, and dates of calibration of all instruments.
- C. Reports: Identify conspicuous items not conforming to Contract requirements in the reports.

3.5 AIR SYSTEM DATA

- A. Report: Include in the certified report, for each air-handling system, the following

data (as applicable):

1. Equipment (fan or factory fabricated station unit):
 - a. Installation Data:
 - i. Manufacturer and Model.
 - ii. Size.
 - iii. Arrangement, Discharge, and Class.
 - iv. Motor H.P., Voltage, Phase, Cycles and Full Load Amps.
 - v. Location and Local Identification Data.
 - b. Design Data: Data listed in schedules on the Drawings and in the Specifications.
 - c. Fan Recorded (Test) Data:
 - i. C.F.M.: Discharge CFM and % of OA under minimum conditions.
 - ii. Static Pressure: S.P. total, S.P. suction and S.P. discharge.
 - iii. R.P.M.: Fan and motor.
 - iv. Motor Operating Amps.
 - v. Motor Operating B.H.P.
 - vi. Motor Sheave Size and Make.
 - vii. Fan Sheave Size and Make.
 - viii. Number of Belts Size and Make.
2. Duct Systems:
 - a. Duct Air Quantities (Maximum and Minimum) - Main, Submains, Branches, Outdoor (Outside) Air, Total-Air, and Exhaust:
 - i. Duct size(s)
 - ii. Number of Pitot tube (Pressure) Measurements.
 - iii. Sum of Velocity Measurements (Note: Do not add pressure measurements).
 - iv. Average Velocity.
 - v. Recorded (Test) C.F.M.
 - vi. Design C.F.M.
 - b. Individual Air Terminals:
 - i. Terminal Identification (Supply or Exhaust, Location and Number designation).
 - ii. Type, Size, Manufacturer and Catalog Identification.
 - iii. Applicable Factor for Application, Velocity, Area, etc., and Designated Area.
 - iv. Design and Recorded Velocities - F.P.M. (State "core", "inlet", etc., as applicable). Record data for three readings and average.
 - v. Design and Recorded Quantities - C.F.M. Record data for three readings and average.
 - vi. Deflector Vane or Diffusion Cone Settings.

3.6 WATER SYSTEM DATA

A. Report: Include in the certified report, for each water system, the following data:

1. Pumps:
 - a. Installation Data:
 - i. Manufacturer and Model.
 - ii. Size.

- iii. Type Drive.
 - iv. Motor H.P., Voltage, Phase, and Full Load Amps.
 - b. Design Data:
 - i. G.P.M.
 - ii. Head.
 - iii. R.P.M.
 - iv. B.H.P and Amps.
 - c. Recorded Data:
 - i. Discharge Pressure (Full-Flow and No-Flow).
 - ii. Suction Pressures (Full-Flow and No-Flow).
 - iii. Operating Head.
 - iv. Operating G.P.M. (From pump curves if metering is not provided).
 - v. No-Load Amps. (where possible).
 - vi. Full-Flow Amps.
 - vii. No-Flow Amps.
- 2. Converters and Heat Exchangers:
 - a. Installation Data:
 - i. Manufacturer, Model and Type.
 - ii. G.P.M.
 - iii. Inlet (entering) and Outlet (leaving) Temperatures.
 - iv. Water pressure drop.
 - b. Recorded Data:
 - i. G.P.M. (if metered).
 - ii. Entering and Leaving Water Temperatures - System.
 - iii. Water Pressure drop.
 - iv. Heating (or Cooling) Media - Conditions Steam Pressure and Temperature and Condensate Temperature, or Entering and Leaving Water Temperature.
 - v. Heating (or Cooling) Media - Flow (G.P.M. or lbs per hour).
- 3. Air Heating Equipment:
 - a. Design Data:
 - i. Load in BTUH or MBH.
 - ii. Entering and Leaving Water Temperature.
 - iii. C.F.M.
 - iv. Water Pressure Drop.
 - b. Recorded Data:
 - i. Type of Equipment and Identification (location or number designation).
 - ii. Entering and Leaving Air Conditions (D.B. and W.B).
 - iii. Entering and Leaving Water Temperatures.
 - iv. G.P.M. (if metered).
 - v. Temperature Rise or Drop.

3.7 FINAL TESTS, INSPECTION AND ACCEPTANCE

- A. General: Make tests to demonstrate that the capacities and general performance of air and water systems comply with the Contract Documents.
- B. At the time of final inspection, recheck, in the presence of the Engineer, random

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selections of data (water and air quantities and air motion) recorded in the Certified Report.

- C. Points and areas for recheck will be selected by the Engineer.
- D. Measurement and test procedures shall be the same as approved by the Engineer for the Work forming basis of report.
- E. Selections for recheck (specific plus random), in general, will not exceed 15 percent of the total number tabulated in the report.
- F. Retests: If random tests elicit a measured flow deviation of ten percent or more from that recorded in the Balance Report listings, at ten percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, readjust all systems and re-test. Submit new data recorded, new Balance Reports and make new inspection tests, all at no additional cost to the Owner.
- G. Marking of Settings: Following final acceptance of Balance Reports by the Engineer, permanently mark the settings of all valves, splitters, dampers, and other adjustment devices so that adjustment can be restored if disturbed at any time. Do not mark devices until after final acceptance.

END OF SECTION

SECTION 16000

ELECTRICAL - PUMP STATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide all labor, materials, equipment, operations, methods and procedures as specifically noted herein these specifications and as indicated in the Contract Documents, together with all items necessary for or incidental to the completion of the work.
- B. All systems or additions to existing systems indicated in the Contract Documents shall mean all necessary supervision, labor, equipment and materials required to provide complete, properly functioning systems.
- C. All systems shall be adjusted, tested, inspected and turned over to the Owner in perfect working order.
- D. The words "provide", "supply", "supply and install", "install", "furnish" or "furnish and install", as used in DIVISION 16 or as indicated on the Drawings related to DIVISION 16 shall mean a complete and properly functioning Electrical installation performed by the Contractor.
- E. References:
 - 1. Refer to each individual drawing within the Contract Documents in order to coordinate material and equipment locations and electrical requirements.
 - 2. Applicable portions of DIVISION 0 and DIVISION 1 are part of DIVISION 16. Refer to these sections for additional information on bidding requirements, general requirements, Section 01800 for equipment start-up, and product substitution.
- F. Work Specified Herein:
 - 1. Visit and examine the project site and become familiar with all existing conditions pertinent to the work to be performed thereon. No additional compensation will be allowed for failure to be so informed.
 - 2. The following scope of work is a brief generalization of the type and extent of the work specified under DIVISION 16. Detailed requirements are indicated on the Drawings and in related sections of the Specifications. The work specified under DIVISION 16 includes, but is not necessarily limited to the following:
 - a. The work specified under Division 16 is inclusive of the electrical work for this project as indicated on the Drawings and in related sections of the Specifications.
 - b. Provide Electrical Service and Distribution System as indicated on the "Single-Line Diagram", related drawings and schedules, and as specified herein.
 - c. Contractor shall be responsible for obtaining temporary power to conduct work as required. Temporary power may be obtained from the local power company or by a temporary generator as required in order to maintain continuous operation of the pump station during the schedule of the

- construction period. The generator and all required fuel are to be supplied by the electrical contractor.
- G. The work shall also include, but not be limited to, the furnishing and installing of the following:
1. Underground electrical service to the pumping station building and electrical equipment.
 2. Raceways and fittings.
 3. Wires and cables.
 4. Service distribution equipment.
 5. Miscellaneous electrical distribution equipment.
 6. Grounding system.
 7. Installation of existing SCADA telemetry system RTU equipment and connections.
 8. Power and control wiring between standby generator and service distribution equipment.
 9. Metering and service disconnect equipment.
 10. Underground power and control wiring to submersible pumps.
 11. Power conduit, wiring and equipment for connections to a portable generator as indicated on the Drawings.
 12. Emergency standby power system equipment and installation.
 13. Complete demolition of existing systems as shown on the drawings for all complete removals and disconnections, removals, relocations, and installations.
 14. All required electrical work for the proposed pump station building as shown on the drawings.
- H. Make all required connections to the pumping station and for the electric service and utilities at the pump station building.
- I. Removals and Relocations:
1. Examine the existing site, structure(s) and installation(s) for the work of all trades which will influence the cost of the work under DIVISION 16. This work shall include removals and relocations relating to the work of all trades which may interfere with, disturb or complicate the performance of the work under DIVISION 16; and relating to the work involving systems, equipment and related service lines which shall continue to be utilized as part of the finished project.
 2. Provide all associated labor, material and costs to include all removals, relocations, and reconnections herein specified, necessary or required to provide operation and coordination of the combined new and existing systems and equipment.
 3. Demolition:
 - a. Disconnect and remove existing equipment, devices, boxes, conduit, and associated electrical equipment as shown on the contract drawings.
 - b. Any demolition or relocation work performed which results in unused openings in control panels, instrument panels, control stations, pull or junction boxes, etc., which are to remain, shall be plugged by appropriate means such that it maintains the integrity of the NEMA classification of the area, as defined on Drawing E-1.

- c. Any demolition or relocation which results in unused openings shall be sealed.
 - d. The work of this Contract involves demolition work. Review all Contract Documents and coordinate with all disciplines for a complete understanding of this demolition work. Provide all new work required to modify these changes along with all requirements for installation of the new work, as shown on the Contract Drawings.
 - e. There are areas where the demolition shall require that existing equipment such as pullboxes, conduit, and wiring, and associated devices be disconnected, removed, or relocated in order for the new equipment to be constructed and installed. In most cases, the detail of these existing conditions has not been shown. This Contractor will be responsible for performing all work necessary to demolish all devices associated with equipment in their entirety for the noted and intended demolition. The Contractor shall visit the site locations and become familiar with the areas where this work is to be performed. Any concerns or issues regarding this work need to be addressed and submitted to the Engineer for clarification prior to submission of the final bid price for the work of this Contract. All costs associated with this work are the responsibility of this Contractor and shall be included as part of the overall costs for the electrical work of this project. No additional costs shall be allowed by this Contractor for any demolition work.
 - f. Disconnect and remove all abandoned conduits, wiring, boxes, equipment, controls, hangers, etc., shown or not shown, which are located within the area of construction under this contract.
- J. Request for Information:
- 1. When there is a conflict or coordination issue, or if additional information is necessary for the contractor to proceed with the intended work, a Request of Information (RFI) form shall be submitted through the General Contractor to the Engineer. The specific issue shall be described in the RFI and shall be sent to the engineer for review and a response provided in an appropriate time period. RFI form shall be available via the General Contractor through the Engineer. This process shall be used as part of the work of this contract. Products FURNISHED but not installed under this section.
- K. Bid Allowance:
- 1. A bid allowance has been established for estimated cost by the power company for the work required by them under this contract. Refer to General Conditions and Bid Forms including Measurement and Payment for exact requirements and costs to be carried as part of the work required under this section. Actual amounts shall be invoiced and submitted by the respective utility company for payment with any credits for this allowance will be returned to the Owner under this contract.

1.2 QUALITY ASSURANCE

- A. In general, the workmanship of the electrical installation shall be as described in the N.E.C.A. Electrical Design Guidelines. All methods of construction, details of workmanship, etc., that are not specifically described therein or indicated in the

Contract Documents, shall be subject to the control and no exceptions to the Engineer.

- B. Equipment and materials shall be of the quality and manufacture indicated in their respective description within the specifications.
- C. Work determined by the Engineer to be unsatisfactory according to industry standards shall be redone at the Contractor's expense, with no additional compensation.
- D. Safety and care of equipment and electrical installations to remain the responsibility of the subcontractor until final acceptance by owner. Any cost associated due to damages or loss prior to owner acceptance to be covered by subcontractor.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit Shop Drawings, O&M Documentation, and manufacturer certificates in accordance with Section 1340 The requirements below are in addition to the standards therein.
- B. Submittals required under this section include, but are not limited to the following for each of the locations specified:
 - 1. Conduit
 - 2. Wiring and Cables
 - 3. Service distribution equipment
 - 4. Main circuit breaker
 - 5. Manual transfer switch
 - 6. Lightning arrestor and line surge protection
 - 7. Receptacles
 - 8. Automatic transfer switch
 - 9. Portable Generator connections
 - 10. Mounting hardware and materials
 - 11. Lighting fixtures and switches
 - 12. Electrical distribution equipment
 - 13. Miscellaneous electrical equipment
 - 14. Pullboxes
 - 15. Control station push buttons and enclosures
 - 16. Expansion fittings
 - 17. Motor starting equipment as required for the installation
 - 18. Variable Frequency Drives (VFDs)
 - 19. VFD parameter settings, VFD software and digital copy of parameters
 - 20. Conduit seal fittings
 - 21. Emergency Standby Systems and Equipment
 - 22. Equipment test results
 - 23. Conduit Layout Plans
 - 24. Megger test results for cables and equipment prior to putting equipment into service
 - 25. Submit all other equipment as required by the Contract
- C. Operations and Maintenance Manual
 - 1. Requirements
 - a. Provide a complete bill of material for each piece of equipment.

- b. Provide a preventative maintenance section for all applicable equipment including recommended schedule and spare parts.
- c. Panels which require customized schematics shall be updated with changes made in the field and submitted on 11" x 17" size drawings. Also internal and front elevation drawings shall be included identifying all equipment.
- d. All equipment shall include a troubleshooting section with common symptoms and recommended solutions.
- e. All equipment shall include emergency operations instructions particularly to Emergency Generators and Automatic Transfer Switches on how to operate the equipment when the automatic function of the equipment fails.

D. Submittals:

- 1. Shop Drawings Shall Consist Of:
 - a. Project name and location.
 - b. Contractor's name.
 - c. Index Sheet - Listing the equipment being submitted utilizing equipment designations, or symbols, indicated on the Contract Documents together with the proposed manufacturer, style/ type and catalog number.
 - d. Manufacturer's scale or dimensioned drawings along with standard catalog "cut" sheets.
 - e. Equipment ratings, service clearances and configuration.
 - f. Listing of accessories to be furnished.
 - g. Single-line and schematic diagrams where applicable.
 - h. Refer to related sections of the specifications for special shop drawing requirements for individual equipment types.
- 2. Provide samples of such items as lighting fixtures and wiring devices upon request of the Engineer.
- 3. Standard manufacturer's catalog cut sheets are acceptable; however, they shall be modified to indicate equipment and options to be provided for this project. Any listed equipment, options, or features which are not to be provided shall be properly indicated in the submittal. Failure to properly indicate project-specific equipment, options, and features will result in the submittal being returned without being reviewed.
- 4. Submit test results as listed in Section 3.4

1.4 PRODUCT HANDLING

- A. All materials shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance.
- B. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out of doors. Electrical equipment shall be stored in dry permanent shelters. If any apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, or shall be replaced at no additional cost to the Owner.

1.5 DESIGN CRITERIA

A. Service and Metering

1. The project site location has existing utility company services for power and telephone. There may be no requirements for the scope of work which will impact these existing services. Therefore, there will be no need for coordination and contact with the respective utility company regarding any shutdowns, energizations, modifications, or interface with the present services which shall affect the work of this contract.

B. Service and Metering

1. The power company serving this project is Eversource. The service representative this project is as follows:
2. Contact Person: Paul Diiorio
3. Contact telephone number: 860-447-5787
4. Contact email: paul.diorio@eversource.com
5. Service is existing and it is not expected that a new service will be required.
6. Coordinate all shutdowns and activations of the services with the power company as part of this work.
7. Make all arrangements with the power company for obtaining service and pay all charges and furnish all labor and material for the service. An allowance has been established for this work. Refer to General Conditions for these specifications for specific bid allowance to be carried as part of the work of this contract.
8. Provide all demolition and removals of existing secondary electrical service conduit and cables at the existing service riser pole and at the existing pumping station and as shown in the Contract Drawings.
9. Provide all service disconnections and re-energizations required by the Power Company during the work of this contract and include these costs as part of the work of this contract as part of the allowance establish for this electrical service work.

C. Codes, Inspection and Fees

1. All material and installation shall be in accordance with the latest edition of the National Electrical Code and the codes and ordinances of the Town or City of which the work is being performed.
2. Pay all fees required for permits and inspections. All power utilization fees incurred prior to owner's acceptance to be paid by subcontractor.

D. Tests and Settings

1. Test all systems furnished under DIVISION 16, ELECTRICAL and repair or replace all defective work.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials and equipment used shall be Underwriters Laboratories, Inc. listed.
- B. Refer to Drawing E-1 for specific references to NEMA ratings for equipment specified unless otherwise noted.

2.2 RACEWAYS AND FITTINGS

- A. Rigid steel conduit shall be hot dipped galvanized as manufactured by Republic Steel Corp., Allied Tube and Conduit Corp., Wheeling Pittsburg Steel Corp., or equal.
- B. Conduit hubs shall be as manufactured by Myers Electric Products, Inc., Raco Div., Appleton Electric Co., or equal.
- C. PVC coated rigid steel conduit as manufactured by Rob-Roy "Plasti-Bond", Ocal, or equal.
- D. PVC Schedule 40 shall be extra heavy wall and UL Listed for the use intended. Acceptable Manufacturers: Carlon, Rob-Roy, or equal.
- E. Aluminum conduit shall be rigid, heavy wall aluminum. Acceptable manufacturers: Anaconda, Kaiser, VAW, or equal.
- F. Electrical Metallic Tubing (EMT) shall be constructed of electro-galvanized steel. EMT fittings shall be interlocking compression type of cadmium-plated malleable iron or zinc coated steel, or stainless steel. No die cast, set screw and indenter type fittings shall be used. Acceptable manufactures are Allied, Wheatland or equal.
- G. Flexible Metal Conduit
 - 1. Flexible Metal Conduit shall be constructed of one continuous length of U. L. Approved electro-galvanized, spirally wound steel strip with interlocking convolutions and interior surfaces free from burrs and sharp edges.
 - 2. Flexible metal conduit shall be "liquid-tight" with PVC jacket. Acceptable Manufacturers: Alfex - a division of Southwire, Electri-Flex, Thomas & Betts - a division of ABB, or equivalent.
 - 3. Flexible metal conduit installed in hazardous, NEMA 7, Class I Div 1 areas shall be UL Listed, and shall have a bronze or stainless-steel braid covering over a flexible brass inner core. Packing shall be woven cotton braid impregnated with asphalt. Acceptable manufacturer: Crouse-Hinds - a division of Eaton, Killark, Thomas & Betts - a division of ABB -XP Series, or equal.

2.3 WIRES AND CABLE

- A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper. All conductors installed below grade shall be XHHW stranded. All conductors #8 and larger shall be XHHW.
- B. Power wiring shall be 600V, Type XHHW. Type XHHW shall be cross linked polyethylene, as manufactured by Pirelli Cable Corp., Collyer Insulated Wire Company, The Okonite Company, or equal.
- C. Control wiring shall be 600V, Type THHW/THHN No. 14 AWG stranded. Type THHW/THWN shall be cross linked polyethylene, as manufactured by the Pirelli Cable Corp., Collyer Insulated Wire Company, The Okonite Company or equal.
- D. Signal wiring shall be 600V, individual shielded twisted pair, No. 16 AWG stranded with polyethylene jacket. Provide Belden Catalog No. 8719, Alpha Wire & Cable, or equal.
- E. Ground wires shall be THW and color-coded green.
- F. Variable frequency drive (VFD) motor supply cables shall be provided where indicated on Drawings. VFD cables shall be four (4) conductor tinned stranded copper, with cross-linked polyethylene insulation, overall foil (100% coverage) / tinned copper braid (85% coverage) shields, No. 12 AWG tinned copper drain wire,

- and outer PVC jacket. Cables shall conform to UL specification for 1000 Volt flexible motor supply cable. Acceptable Manufacturers: Belden, Olflex, or equal.
- G. Ethernet wiring shall be Category 6, 4-pair 24 AWG solid bare copper conductor, unshielded, FEP insulated, plenum rated. Acceptable manufacturers shall be Belden, Omni, or equal.
 - H. Wire markers shall be "OMNI GRIP" as manufactured by W.H. Brady Company, or equal.
 - I. All wires and cables specified and installed underground shall be U.L. Listed and Labeled for underground use for all installations.

2.4 AUTOMATIC TRANSFER SWITCH

A. GENERAL

1. The automatic transfer switch shall be designed for an emergency and normal source with ratings as indicated on the drawings. The automatic transfer switch shall be as manufactured by the generator manufacturer.
2. The transfer switch manufacturer shall have been regularly engaged in the production of UL (Underwriters Laboratory) Standard 1008 Listed transfer switches. The transfer switches shall be documented, and have been offered for sale on the open market for a minimum of five (5) years. The manufacturer shall provide factory trained parts and service support through a factory authorized distributor that is regularly doing business in the area of the installation.
3. The manufacturer shall supply literature containing diagrams, parts lists and descriptions sufficient for the owner's personnel, or subcontract supplier to install, operate and perform normal maintenance on the equipment.
4. Testing: To provide proven reliability of the system, transfer switches shall be completely tested as follows:
 - a. Representative production samples of the transfer switches supplied, shall be demonstrable, through tests, the ability to withstand at least 10,000 mechanical operating cycles. An operating cycle shall consist of one (1) electrically operated transfer from normal to emergency and back to normal.
 - b. During the development of the original transfer switching mechanism for this family of transfer switches, a prototype of the transfer switching mechanism shall have passed the environmental tests listed in Military Standard, Mil-Std-202E. These tests shall include Method 101D-Condition B, Salt Spray-Corrosion; Method 103B-Condition B, Humidity; Method 107D-Condition A, Thermal Shock; Method 110A Sand and Dust.
 - c. Transfer switches shall be UL Listed per Standard 1008. The minimum WCR (Withstand and Closing Current Ratings) shall meet the requirements of UL Standard 1008 and shall be obtained without contact welding. Where the line side overcurrent protection is provided by circuit breakers at 480 volts AC or less, the short circuit WCR shall be as follows:

TRANSFER SWITCH
CONTINUOUS

K & J/L
FUSES

WITHSTAND
AND

CURRENT RATINGS

40A, 70A, 100A

150A, 260A

400A, 600A

800A, 1000A

125A/200A*

400A/600A*

1200A/1200A*

2000A/2000A*

CLOSING RATINGS

14,000A RMS

30,000A RMS

65,000A RMS

65,000A RMS

* Class J and L Fuses WCR = 200,000A RMS

- i. The RMS (root Mean Square) symmetrical fault current ratings shall be verified by UL witnessed tests on representative test samples. All WCR tests shall be performed with the overcurrent protective devices located external to the transfer switch. Tests conducted with overcurrent protective devices internal to the transfer switch, in such a manner that the transfer switch interrupts the current rather than withstanding the current, are not acceptable under this definition of withstand.
 - ii. Where the line side overcurrent protection is provided by current-limiting fuses, the fuses shall be UL Class RK1, RK5, J, or L (with the fuse sizes being no larger than the UL listed maximum ratings or component recognition procedures for the transfer switches supplied). The transfer switch closing rating shall be suitable for 200,000A available fault current, as verified by UL witnessed tests on representative test samples.
- d. Provide testing as specified herein.
5. Ratings: All transfer switches shall be UL Listed per Standard 1008. All transfer switches shall be suitable for use on emergency and legally required standby systems in accordance with ANSI-C1 and NFPA-99, rated for total system load. These loads shall include motors, electric discharge lamps, resistive loads, and tungsten lamps as described in Section 1 of UL 1008 Standard.
6. Transfer switches shall be 60 HZ. Refer to drawings for the number and locations of transfer switches, number of phases, number of poles, voltage, and ampere ratings.
7. Transfer switches shall be rated to carry 100 percent of their rated current continuously when in an enclosure. Refer to enclosure requirements as shown on the Drawings for each specific project location. Transfer switches which must be derated when installed in an enclosure (due to integral overcurrent devices or any other reasons) do not meet this specification. Transfer switches shall be rated for continuous operation in ambient temperatures of -40° C (-40°F) to 67°C (142°F).
8. Construction: Transfer switches shall be over center operation, double-throw construction, center neutral position type positively electrically and mechanically interlocked by a simple mechanical beam to prevent simultaneous closing (for break before make operation), and mechanically held in both normal and emergency positions.
 - a. Transfer switches shall be quick-break, quick-make operation so that the speed of opening and closing is not controlled by an operator during

manual operation. Transfer switches shall be a center neutral position type switch and shall provide a center "Programmed Transition" position for manual switching.

- b. Transfer switches shall be approved for manual operation under full load by integral mounted, permanently attached, high dielectric, manual operating handles. Manual operating handles, which are normally stored and must be installed for manual operation, do not meet this specification.
- c. The electrical operating means shall be a direct-acting, center neutral position, constant force in both directions, bi-directional linear induction motor to provide minimum friction, straight-line switch action. Motor shall be attached directly to the switching mechanism without the use of gears, cams, or other complex mechanical linkage methods.
- d. Transfer switches shall not contain any integral overcurrent devices in the main power circuit, including molded case circuit breakers or fuses.
- e. The transfer switch electrical actuator shall have an independent disconnect means to disable the electrical operation during manual switching.
- f. Manual operating handles and controls (other than key-operated switches) shall be accessible to authorized personnel only by opening the keylocking cabinet door. Transfer switches located on the outside of the cabinet do not meet this specification.
- g. Unless noted or specified otherwise, each transfer switch shall be mounted in separate cabinet enclosures with key-locking front doors and no mechanical clips or fasteners located around the outside of the enclosure door as specified herein.
- h. Maximum transfer time in either direction shall be six (6) cycles, except where the "Programmed Transition" feature is furnished.
- i. All transfer switches shall have transparent protective covers to protect operating personnel during manual operation, and to allow an operator to visually determine that the main contacts are "Open" or "Closed".
- j. The main switch contacts shall be of the no maintenance type and high pressure silver cadmium oxide to resist burning and pitting for long life operation. All switches shall have arc chutes of heat absorbing material and metal leaves for positive extinguishing of arcs quickly and effectively; arc chutes shall have insulating covers to prevent interphase flashover.
- k. Transfer switches shall have one (1) S.P.D.T. (Single Pole Double Throw), auxiliary dry switch contacts on both the normal and emergency-sides, operated by the transfer switch. These auxiliary switch contacts shall be factory wired to an easy access terminal block and may be used to monitor transfer switch position for controlling indicator lamps or other peripheral equipment. Contacts shall be rated 1200 VA.
- l. Complete AL-CU (Aluminum-Copper) lugs, UL listed and CSA certified, shall be provided for both normal and emergency load positions. Provide all required lugs/phase for each switch based on cable sizes shown on the Contract Drawings. For 150A and larger transfer switches, top or bottom feed for load connections shall be provided for slimmer design, requiring

- less wall space. Load connections shall be field changeable either from top-to-bottom or bottom-to-top. Wiring space at normal, emergency, and load lugs inside the transfer switch cabinet shall comply with the latest edition of NEC. Full rated neutral bar with lugs for normal, emergency, and load neutral conductors shall be provided inside the cabinet.
- m. Relay, with 2 N.O. and 2 N.C. contacts, which is energized whenever the normal source is available regardless of switch position.
 - n. Relay with 2 N.O. and 2 N.C. contacts, which is energized whenever the emergency source is available regardless of switch position.
9. Controls: Control accessories, either electronic or relay, shall be mounted in a separate smaller cabinet mounted on the inside of the main cabinet door. This is to allow for ease of service when the main cabinet lockable door is opened, but to prevent access by unauthorized personnel. Controls shall be microprocessor based type with operator interface panel for monitoring, viewing and setting of system parameters.
- a. Control circuit disconnect plugs shall be provided to reenergize control circuits to avoid the hazards of electrical shock to personnel while making adjustments.
 - b. The Power Sentry electronic control, undervoltage and time delay modules, shall be a printed circuit board for ease of service. The solid-state undervoltage sensors shall simultaneously monitor all phases of the normal and emergency power sources to provide field adjustable range sensors for specific applications.
 - i. Voltage pickup settings shall be adjustable from a minimum of 85% to a maximum of 100% of nominal voltage. Voltage dropout settings shall be adjustable from a minimum of 74% to a maximum of 98% of the pickup setting with a fixed dropout time delay of 0.5 second.
 - ii. Voltage sensors shall be of the temperature compensated type, for maximum deviation over the temperature range of -32°C (-25°F) to 79°C (175°F). Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase of the normal or emergency power source, even where motor feedback voltages exist.
 - iii. Provide phase failure (loss of any phase) phase unbalance and phase rotation type sensing for protection of all phases of the system.
 - c. The Overvoltage and Frequency Sensing control, overvoltage and frequency sensing module, shall be a printed circuit board for ease of service. The solid-state overvoltage sensor(s) shall simultaneously monitor all phases of the source(s) to provide field adjustable ranges of voltage pickup and dropout and time delays. Frequency sensor(s) shall simultaneously monitor all phases of the source(s) to provide field adjustable ranges of frequency pickup and dropout and time delays.
 - i. Under/over frequency and over voltage sensing for the emergency source.
 - d. Controls shall signal the emergency power system to start upon signal from normal source voltage sensors. Solid-state adjustable time delay (0-

- 90 sec) start shall avoid nuisance engine-generator set start-ups on momentary voltage dips or interruptions. Initial setting shall be 5 seconds.
- e. The transfer switch shall transfer the load to the emergency power system after the engine-generator set reaches proper voltage and frequency and has stabilized.
 - f. The transfer switch shall control the engine-generator set to allow the set to start and transfer the load within 10 seconds (adjustable from 2 to 120 sec) after a normal source power failure. It shall be the responsibility of the transfer switch supplier to meet this requirement.
 - g. The transfer switch shall retransfer the load to the normal source after normal source power is restored, allowing normal source to stabilize before retransfer and shall allow staggered retransfer of loads in multiple transfer switch systems. Retransfer time delay shall be adjustable from 0-30 min. Initial setting shall be 3 minutes.
 - h. The controls shall signal the engine-generator set(s) to stop after load retransfer to the normal source but shall maintain the availability of the emergency source in the event that the normal source fails shortly after retransfer. The controls shall allow the engine-generator set(s) to run unloaded for a cooldown period prior to shut down (adjustable from 0 to 10 min). Initial setting shall be 5 minutes.
 - i. The controls shall provide an automatic retransfer of the load from the emergency source to the normal source if the emergency source fails when the normal source is available.
 - j. The transfer switch operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred.
 - k. Controls shall provide built-in "Control Mode Status" indicators, mounted on the interior of the enclosure, consisting of L.E.D.s (Light Emitting Diodes) to indicate a sequence of functions such as the following:
 - i. Source 1 OK
 - ii. 2-Wire Run
 - iii. Source 2 Ok
 - iv. Timing for Transfer
 - v. Transfer Command
 - vi. Timing for Retransfer
 - vii. Retransfer Command
 - viii. Timing for Stop
 - l. The indicators shall allow the operator to determine that the controls are properly sequencing and shall assist in determining the sequence of any malfunctions that might occur.
 - m. Main cabinet front door mounted controls and indicator lamps shall consist of oil-tight, neon position indicator lamps (NORMAL - White and EMERGENCY - Amber) and key-operated Test and Selector switches to provide the following functions:
 - i. TEST - Simulated normal source power loss to control unit for testing engine-generator set capability. Provide selector switch inside cabinet to allow for choice of load transfer or test without

- transfer.
 - ii. NORMAL - Normal operating position and also restores the system to stand by operation; and if load was transferred, retransfers load from emergency to normal source after test and time delays.
 - iii. RETRANSFER - Spring-loaded momentary position of switch, that overrides retransfer time delay to cause the immediate return to the normal source after a test or actual power outage.
 - n. Transfer switch shall be provided as a delayed transition, center neutral position switch. This feature shall be provided to allow for delay residual voltage of connected load. The time delay shall occur during switching in both directions, during which time the load is isolated from both normal and emergency sources. This will allow residual voltage components of motors or other inductive loads (such as transformers) to decay before completing the switching cycle.
 - o. The center neutral, delayed transition shall be connected in a manner that will not cause the time delay in switching, where the time delay has already been established by the loss of voltage to the load during normal source power interruptions.
10. Switches shall be equipped with the following items:
- a. Provide microprocessor based controller and Exerciser clock to set day-of-week (one week dial minimum), time-of-day, and duration-of-time of engine-generator set(s) exercise. A period with/without load selector switch.
 - b. Provide Manual-Automatic retransfer selector switch. After normal source is restored, this switch provides either manual or automatic retransfer after the retransfer time delay has expired in the automatic position, or manual retransfer at a time selected by an operator.
 - c. Frequency reading of 45-65 HZ.
 - d. Generator running time meter reading in hours.
 - e. Multi-position AC readings and phase selection to read line current and line-to-line and line-to-neutral voltages in each phase with off position.
 - f. Meter(s) shall read whichever source is connected to the load.

2.5 MAIN CIRCUIT BREAKER

- A. Circuit breaker shall be molded case, 600 Volts, sized as indicated on the Drawings with not less than Amperes, RMS interrupting capacity as shown on the drawings. Circuit breaker shall be installed within an enclosure with neutral and ground lug kit factory installed and provided in the enclosure. The operating handle shall be side mounted and pad lockable in the "On" and "Off" position. The breaker should still provide overload and short circuit protection when locked in the "ON" position.
- B. Circuit breaker shall be UL listed and labeled as being suitable for use as service entrance equipment.
- C. Acceptable manufacturers are Square D, Cutler Hammer, or equal.

2.6 GROUND ROD

- A. 10 foot long by 3/4 inch diameter copper clad steel ground rods shall be provided, arranged and installed as shown on the drawings. Provide all required Cadwelds,

grounding clamps and hardware as required for a complete installation per NEC and as shown on the drawings.

- B. Acceptable manufacturers are Erico, AB Chance Co., or equal.

2.7 LIGHTNING AND SURGE PROTECTION

- A. Lightning and surge protection units shall be Square D Model Number SDSA 3650, three phase for 600 VAC phase-to-ground voltage. Provide a separate unit at all locations shown on the drawings. Provide a spare lightning and surge protection unit to the Owner for spare parts.
- B. Lightning and surge protection units shall be Square D Model Number SDSA 1175, single phase for 250 VAC phase-to-ground voltage. Provide a separate unit at all locations shown on the drawings. Provide a spare lightning and surge protection unit to the Owner for spare parts.

2.8 WIRING DEVICES

- A. Receptacles shall be duplex, 20 Ampere, industrial grade and shall be ground fault type. Outdoor receptacles shall be provided with weatherproof, while in use type covers.
- B. Light switches shall be rated 20 Ampere, single pole type.
- C. Duplex receptacles shall be duplex, 20 ampere, industrial grade type.
- D. Covers shall be stainless steel gasketed for exposed or concealed inside locations and weatherproof while in use covers for outdoor locations.
- E. Provide 20A, 125V ENR Series dead front interlocked circuit breaking receptacles as shown on drawings. Refer to contract drawings for additional information. Crouse-Hinds Cat# ENR21201.
- F. Acceptable manufacturers are Cooper, Hubbell, or equal.

2.9 POWER DISTRIBUTION PANEL PDP

- A. Provide power distribution panel board with bolt-on breakers and copper busses. Panelboard shall be rated as shown on the drawings, but not less than 22,000 Amperes RMS Symmetrical. Panel board shall be provided as shown and noted on the contract drawings. Acceptable manufactures are Square D, Cutler Hammer, or General Electric, or equal.
- B. Submit complete documentation for coordination, short circuit, and arc flash study and report immediately upon approval of equipment and prior to start-up and testing of any equipment. Submit reports prior to release of equipment in order to make any necessary changes based on the study's findings before the equipment is approved. No start-up will be allowed without this study and report and without the final recommended system settings being implemented and tested in the field. If equipment needs to be ordered prior to receiving the study, all necessary changes will be the responsibility of the contractor at no additional costs.

2.10 LIGHT FIXTURES

- A. Refer to lighting fixture schedule on the Drawings for specific requirements.
- B. Acceptable manufactures are Cooper Lighting, Holophane, or equal.

2.11 EXPANSION FITTINGS

- A. Expansion fittings shall be watertight expansion type, designed to compensate for conduit movement. Expansion fittings shall be provided to allow movement of 4 inches in both directions for a total of 8 inches. Fittings shall have flexible copper braid bonding jumpers, neoprene sleeve and stainless-steel bands. Acceptable Manufacturer: O.Z./Gedney Type EX, Thomas & Betts, or equal.

2.12 PULLBOXES AND JUNCTION BOXES

- A. Junction boxes shall be cast malleable iron or aluminum type and gasketed type FS series with hubs.
- B. Pullboxes other than explosion proof shall be seamless weld type, galvanized with flush type screw-on covers and no hinges or side clamps all around. Use Myers hubs for conduit termination and entry into pullboxes. Acceptable manufactures are Rittal, Hoffman, or equal.
- C. Explosion-proof pullboxes shall be NEMA 4/7, Class I, Division 1, Group C & D or NEMA 4/7, Class I, Division 2, Group C and D for hazardous rated areas. Provide conduit sealing fittings inside and outside of explosion proof areas for all conduits per NEC. Acceptable manufactures are Appleton, Crouse Hinds, or equal.
- D. Boxes for concealed work shall be used only for concealed installations.

2.13 MOUNTING SUPPORTS AND HARDWARE

- A. Provide 316 stainless steel uni-strut and 4" channel angle supports and stainless-steel mounting plates as shown and required for equipment mounting. All legs for stanchion mounting structures shall be channel angle support, no exceptions.
- B. All bolts, washers and mounting hardware shall also be 316 stainless steel for the entire installation.
- C. Acceptable manufactures are B-Line Systems, Inc., Thomas & Betts-Super Strut, Unistrut, or equal.

2.14 LINK SEAL

- A. Furnish and install link seal fittings at all areas of buildings and structures both above and below grade for conduit entry. Refer to the contract drawings for additional requirements.
- B. Acceptable manufactures are Innerlynx, Crouse Hinds, or equal.

2.15 DISCONNECT SWITCHES

- A. Furnish and install heavy duty type lockable disconnect switches as shown on the drawings. Switch NEMA ratings shall be as required and noted on the drawings. Ampacity shall be noted on the drawings and as required by NEC.
- B. Disconnect switches, indicated on the drawing to be used for motors controlled by variable frequency drives shall be 4 pole type switches. The fourth pole shall be wired directly to the control circuit, in series with the safety e-stop, in order to lock-out and immediately shutdown the drive control circuit. The auxiliary 4th pole shall open prior to any of the other three power poles and shall be specifically designed for proper use with VFD type load circuits. The Contractor shall be responsible for providing a separate control conduit for required wiring from the VFD to the disconnect switch.
- C. Acceptable manufactures are Square D, Cutler Hammer, or equal.

- D. Disconnect switches shall have side mounted handle operators that are lockable in both the on and off position.
- E. Disconnect switch shall lock out and immediately shutdown the drive control circuit. The auxiliary 4th pole shall open prior to any of the other three power poles and shall be specifically designed for proper use with VFD type load circuits. The Contractor shall be responsible for providing a separate control conduit for required wiring from the VFD to the disconnect switch.
- F. Acceptable manufactures are Square D, Cutler Hammer, or equal.

2.16 MOTOR CONNECTIONS

- A. Provide all required flexible conduit liquid tight or explosion proof to meet the NEMA rating as noted on the drawings. Limit lengths to 24" or less. Moved to cable section.

2.17 PHASE FAILURE RELAYS

- A. Provide phase failure relays when three phase power and equipment is present. Phase failure relays shall be three-phase, three-wire rated for use at the voltage indicated on the drawings. When the relay is in an energized condition, a loss of power or a phase unbalance of more than 10% and/or phase reversal shall cause the output relay to de-energize, returning NO contacts to their passive state. The relay shall automatically reset when the correct conditions are re-established. Phase failure relays shall be equipped with a built-in 0.2 second time delay to prevent nuisance tripping. Phase failure relays shall be open-type to be mounted within motor starter compartments. Relays shall be Cutler-Hammer Type P or equivalent.

2.18 RELAYS

- A. Industrial Control Relays - Relays provided with 10 Ampere contact rating shall be Square D, Class 8501 type X or equal. Relays with 30 Ampere contact rating shall be Square D, Class 8501, type C or equal.
- B. Pilot Duty Relays - General purpose relays shall be IDEC RH Series, 10A contact rating, 4 Form "C" contacts or equal, provided with internal indicating light. Pilot duty control isolating relays for PLC inputs and outputs shall be suitable for the application and shall be submitted with no exceptions by Engineer.
- C. Relays shall be electrically operated with 120 Volt coils except as noted otherwise on the Drawings. Contacts shall be rated 600 Volt, 10 Ampere.
- D. Interposing relays used for telemetry inputs or other low current inputs shall be Potter and Brumfield type KHAU-17A16 - 120 Volt, or equal.
- E. Timing Relays:
 - 1. Delay timing relays shall be general purpose, solid state type rated for use at 120 Volts. Contacts shall be rated 5 Amperes (minimum). Minimum time range shall be adjustable from 1 second to 1 minute. Time delay relays shall be IDEC RTE or equal.

2.19 TERMINAL STRIPS

- A. Terminal strips shall be supplied to make all power and control connections. All terminals shall be numbered and clearly marked for easy identification. Acceptable manufacturers are Allen Bradley, Phoenix Contact, or Equal.

2.20 WIRE IDENTIFICATION

- A. All individual conductors shall be identified using unique numerical tags corresponding to conductor designations indicated on approved shop drawings of schematic diagrams for all terminations. This includes all process- and non-process-related wiring done as part of the work, such as fire alarm panels. Conductors shall be clearly identified at each terminal block, equipment connection and junction. Markings shall utilize the equipment designation and terminal block number in the device higher upstream in the system hierarchy.
- B. For Conductors No. 6 and smaller, color coding shall correspond to the color of the conductor insulation. For color coding of wire larger than No. 6, use self-adhesive, wrap-around type markers. These markers shall be used at all panelboards, junction boxes, disconnect switches, circuit breakers, etc.

2.21 CONTROL POWER TRANSFORMERS

- A. Supply all control power transformers necessary to make panel functional. All transformers shall have both primary legs and all "hot" secondary legs fused. One secondary leg shall be grounded.
- B. Acceptable manufacturers are Square D, Siemens, or equal.

2.22 CONTROL CIRCUIT FUSES

- A. Fuses shall be rated for at least 125 Volts at the current ratings shown on the Drawings.
- B. Fuses shall be Littlefuse, Bussmann, or equal.

2.23 MOTOR STARTERS

- A. Fractional Horsepower Single-Phase Manual Motor Starter shall be provided with thermal overload(s) and red running indicating light. Starters shall be rated for 120 Volt operation.
- B. Three-Phase Motor Starters shall be combination (480 Volt or 208V), 3-phase, starter/disconnect type, have phase loss relay protection, employing magnetic starter (NEMA Size 1 minimum), with thermal overload protection for each phase and with an M.C.P. type circuit breaker/disconnect sized per the circuit breaker manufacturer's recommendations for coordination with the thermal overload protection. Combination starters shall be provided with a control power transformer with primary and secondary fusing.
- C. Solid-state, reduced-voltage, three phase motor starters shall be (480 volt or 208V), 3 phase and shall be provided as shown on the Drawings. Enclosures for starters shall be based on location classified and drawing E-1. Provide all front mounted controls, lights, nameplates for all front mounted devices, elapsed time meter and nameplate at top center of enclosures which identifies equipment title. Also provide a through the door lockable MCP.
- D. Starters shall be rated 22,000 ampere RMS symmetrical and enclosure requirements shall be as specified under Section 16160.
- E. Starters shall be provided with the following features:
 - 1. Two (2) Primary and one (1) Secondary fuse protection for CPT and as shown on the drawings.
 - 2. Individual control power transformers (CPT). Oversized as required.

3. Individual motor overload protection.
 4. Time delay staggered starting control.
 5. Auxiliary contacts for remote indication.
 6. Controls and indication as shown on the drawings.
- F. All starters shall be customized for the specific application as specified and shown on the drawings.
- G. Provide an explosion proof motor rated switch with ampere rating not less than twice the full load current of the sump pump to control the motor at the platform as indicated on the drawings.
- H. Provide a fractional horsepower manual motor starter with thermal overloads, reset, and lockout provisions.

2.24 CONDUIT SEALS

- A. Provide Class I, Div. 1, Groups C & D conduit seals as required by the N.E.C. and as shown on the Drawings or required by the NEC.
- B. Provide Class I, Div. 2, Groups C & D conduit seals as required by the N.E.C. and as shown on the Drawings or required by the NEC.
- C. Acceptable manufacturers: Appleton, Killark, O-Z/Gedney, or equal.

2.25 DRY-TYPE TRANSFORMERS

- A. Furnish and install dry-type transformers with ratings as shown on the drawings.
- B. Transformers shall be of the energy efficient type and shall be ventilated type only.
- C. Acceptable manufactures: Cutler-Hammer, Square D, Siemens, or equal.

2.26 LIGHTING PANELBOARD

- A. Provide panelboard with main circuit breakers center mounted separate from the feeder breakers sized as shown on the drawings. Panelboard shall have bolt on breakers and copper busses rated as shown on the drawings but shall not be less than 10,000 ampere RMS symmetrical. Provide circuit breakers as noted on the drawings.
- B. Acceptable manufactures are Square D, Cutler Hammer, General Electric, equal.

2.27 LOW LOSS RADIO ANTENNA CABLE

- A. The existing remote telemetry panel (RTU) and radio antenna are to be relocated to the new generator building. Therefore, new radio antenna cable shall be furnished and installed for this reinstallation of this existing equipment.
- B. Provide low loss radio antenna cable, connectors, lightning arrestor, grounding etc., required for a completely compatible installation which presently exists for this interface. Coordinate all work with the Owner and provide "an equal" or better type of antenna cable and connection for this reinstallation.

2.28 BUILDING LOW TEMPERATURE ALARM THERMOSTAT

- A. Furnish and install a building low temperature alarm thermostat. Provide a Honeywell or equal 0-100 degrees F adjustable wall mounted thermostat with a 10 ampere, 120 volt output dry contact for remote indication. Thermostat shall be heavy duty type and be mounted on a fiberglass backpanel off of the wall.

2.29 VARIABLE FREQUENCY DRIVE CONTROL PANEL

- A. Furnish and install a variable frequency drive (VFD) control panel for the submersible pump. VFD control panel shall be installed in a vented type enclosure with the following equipment:
 - 1. VFD Equipment shall be Toshiba, ABB, Yaskawa or approved equivalent.
 - 2. Line Reactor 5%/Matrix Filter/RFI/EMI Filter/See Drawings
 - 3. Single free-standing enclosure with all associated equipment located within this panel which shall operate the respective sewage pump. No separately mounted devices outside this panel will be acceptable.
 - 4. Through the door disconnect switch.
 - 5. Front panel mounted keypad.
 - 6. The application shall provide for a 480-volt three phase input under normal electrical service to the VFD control panel and a 480-volt three phase input during emergency standby electrical service to the VFD control panel. The sewage pumps at Old Norwich are rated at 85HP at 460- volt 3-phase as shown on the drawings.
 - a. Full Load Current = 94 Ampere
 - b. Maximum Full Load Current at Service Factor = 122 Ampere
 - c. Locked Rotor Current = 750 Ampere
 - 7. The final sizing of the VFD equipment shall be based on the following criteria:
 - a. 110% Continuous Output Current
 - b. 150% Overload Current for 2 Minutes
 - 8. Refer to contract drawings for specific requirements and number of VFD units required.
 - 9. Provide all programming and setup for the VFD. Provide VFD Parameter Setup and Verification.
- B. Provide a complete and operational VFD control panel for the submersible pump motor.
- C. Provide a total of one (1) day of startup for the VFD equipment after confirmation of pre-startup has been completed. Reference Section 01800 for coordination of startup requirements.
- D. Provide 1 day of separate training.
- E. Refer to drawings for wiring requirements.
- F. System Analysis
 - 1. The VFD supplier shall perform a computer simulated power system study to verify compliance with the parameters as stated herein. The results of this study shall be submitted to the engineer. At a minimum the submitted results of this study shall include:
 - a. A brief summary of the equations and calculation procedures used in the study.
 - b. A results summary sheet which briefly describes the power system configuration analyzed and which states the calculated values of total harmonic distortion, notch depth and notch area.
 - c. Computer generated graphs which illustrate the voltage and current waveforms of the power system with the VFD's operating. These waveform graphs shall directly illustrate the results of the power system computer model study.

- d. Detailed list of the amplitude of harmonic currents and voltages to the 50th harmonic.
- 2. The contractor shall supply the VFD supplier with all power system data required to perform the above described study. These data may include but are not limited to:
 - a. A complete one-line diagram of the subject electrical distribution system. The diagram must show the lengths of all bus and cable runs, impedance values of all types of bus and cable used, and number of conductors per phase.
 - b. Complete electrical data on all equipment shown on the one line diagram is required. At a minimum this data shall consist of: Transformers - kVA, Primary voltage, Secondary voltage, Short circuit capacity or impedance. Motors - Stator resistance, No load RMS current, No load kVA, No load kW, Locked rotor RMS current, Locked rotor kVA, Locked rotor kW, Horsepower, Base speed, Number of poles, Efficiency at relevant speeds, Power factor at relevant speeds, Full load RMS current. Generators - Short circuit capacity or Subtransient reactances (Xd), Power factor, kW, X/R Ratio.
 - c. If the distribution system can function in more than one configuration, the configuration(s) to be analyzed shall be clearly defined. Any other information which may affect the behavior of the distribution system shall also be provided.

2.30 ELECTRICAL EQUIPMENT ENCLOSURE

- A. Provide a free standing heavy-duty stainless-steel weather tight and corrosion resistant pedestal enclosure. The enclosure shall not have any side clips around the edges and the only means of entrance shall be a key lockable handle. Devices requiring mechanical coins or quarter turn latches are not acceptable.
- B. Pedestal enclosures shall be made of 12-gauge aluminum with ¼ inch by 2-inch by 2 inch channel support on walls, roof and base. The enclosure shall be sized to house all equipment as shown on the Drawings and shall be located as shown on the Drawings. Final sizing shall be submitted as a shop drawing with all equipment shown to scale and dimensioned for performing a final review. The Contractor is responsible to coordinate and provide the correct sizing at no additional cost to the Owner.
- C. The enclosure shall be U.L. listed and labeled as a complete assembly. The final sizing of the enclosure based on the supplied equipment to be selected by the contractor shall be the responsibility of the contractor.
- D. Enclosure shall have full height hinged doors. Doors shall have vault type key lockable operating handles with three-point latch.
- E. Doors shall be fully gasketed with opening of sufficient size to permit ready removal of any of the equipment installed in the compartments. Number of doors and arrangement shall be based on overall width of enclosure. Support posts shall not interfere with clearance access between doors to equipment. The enclosure shall have an aluminum mounting backboard with ground lug assembly mounted to backboard and enclosure for system grounding.
- F. Six sets of keys for each lock shall be furnished. Padlocks shall have forged brass

case with brass shackle. Locks and keys shall match the present type of the Owner's other locations and shall be keyed alike.

- G. Pedestal roof shall slant to the rear of the enclosure.
- H. Drip shield shall extend over door opening.
- I. All exposed hardware shall be stainless steel.
- J. The Contractor shall submit a final shop drawing with all equipment shown and dimensioned for final layout of panel and sizing of panel. Coordinate the layout in the field with the Engineer as to allow for door access and avoid interference with other equipment and enclosures.
- K. Dimensions if shown on the drawings are for reference only. The electrical enclosure shall have sufficient space to mount all equipment with proper clearances and height requirements as required per NEC. The final sizing is the responsibility for the contractor.
- L. Heat dissipation is required to remove excess heat from within the enclosure for the Power Equipment Enclosure. This has not been shown on the drawings for clarity. Provide a complete system to include thermostat, fan, in-take louver, and out-take louver required to properly cool the enclosure. The system specified below is manufactured by Hoffman/miscellaneous equipment:
 - 1. Cooling Fan Package, Hoffman Catalog #TFP61SS (115 volt, Type 1 washable foam filter, 140 CFM @ 60 HZ, SS grille, composite air plenum, finger guard).
 - 2. Exhaust Grille, Hoffman Catalog #TEP6SS (stainless steel w/ Type 1 washable foam filter).
 - 3. 2-fan shroud kits, (1 on intake and 1 on exhaust), Hoffman Catalog #T103RSS.
 - 4. Line voltage thermostat: Honeywell T631C1103.
 - 5. Fractional 120V Manual Motor Starter: Square-D FG-1P
 - 6. The fan shall be controlled by a thermostat and power shall be obtained from a circuit breaker from the lighting panel within the electrical equipment enclosure.
- M. The enclosures shall be insulated and heated as a factory-installed requirement. Field installations after the fact will not be acceptable. Insulate the inside of all exterior surfaces with 1-inch thick rigid fiberglass insulation board having a maximum thermal conductivity ("k" value) of 0.35 BTU-in/hr-ft²-°F. The insulation shall be finished with manufacturer's standard all service jacket. Coverings containing foil will not be acceptable.
- N. For outdoor installations, heat/sun shields fabricated from 0.125 marine grade aluminum shall be installed on front, back and sides of enclosures and control panels housing electrical components. Holes shall be cut in shield for alarm light and horn. Heat shields shall also have white polyester powder coat finish on all sides. Provide cut-outs in the back of the enclosure to accept VFD aluminum mounting plates. Mounting plates shall be attached to studs on the back of the enclosure and gasketed. VFD enclosures located outside shall be NEMA 12/3R with the VFD heat sinks vented out the back. Consult VFD manufacturer's installation guide for flange mount cut-out dimensions and recommended instructions. The rear sunshield shall have a removable cover with handles to allow access to the VFD heat sinks for cleaning and maintenance. The heat shield shall have studs with wing nuts for attached the removable cover. Seal all penetrations

2.31 BRANCH CIRCUIT BREAKERS

- A. Provide 20 Ampere, 120 Volt circuit breakers where indicated on drawings.
- B. Circuit breakers shall be thermal magnetic and maintain the UL Listing of the equipment being installed. Interrupting short circuit rating shall be equivalent or exceed to equipment housing device.
- C. There are several locations where branch circuit power shall be required to be extended to serve new or existing equipment. The contractor shall be responsible to add additional circuit breakers to this existing equipment and shall meet or exceed all ratings of this equipment.
- D. Where these devices are not available or replaceable the following shall be included as an alternate means of installation:
 - 1. Panelboard Installation - If not available then a 4 circuit sub panel shall be installed and tapped by the tap rule of NEC and installed adjacent to the existing panelboard in order to meet this requirement.
 - 2. Installed within existing Pump Control Panel - If not clearly enough room to add then install a DIN mounted breaker adjacent within interwiring to existing breakers.
- E. The contractor shall carry the higher cost installation in the final bid price if determination of this requirement cannot be identified.

2.32 CABLE SEALS

- A. Conduit sealing bushings to seal the ends of conduits entering enclosures from below grade shall be OZ Gedney Co., Type CSB Series or equal.

2.33 LOCAL CONTROL STATIONS

- A. Provide a stainless-steel enclosure with NEMA rating as shown on drawings. The number of devices the enclosure shall be able to hold shall be as shown on drawings. Enclosure shall have sufficient depth to accommodate mounting four Class 9001 KA-1 contact blocks side by side.
- B. Provide heavy duty oil tight/water tight operators as indicated on drawings and as described below:
 - 1. Selector switches shall be removable from the front of the control station without disturbing the wiring or mounting of the control unit. Selector switch shall be bat wing type, 30mm in size.
 - 2. Emergency stop pushbuttons shall be large operator head type, red mushroom-head, maintained type switch. The operation shall be push to open and pull to re-engage. Provide multiple output contacts as shown on the drawings without disturbing the wiring or mounting of the control unit.
 - 3. Indicator lights shall be 30 mm, Push-to-Test, heavy duty, oiltight with LED lamps and designed to operate at 120 Volts, 60 Hz AC. Indicator lights shall be provided with mounting rings, engraved as indicated on the Drawings. Lens color shall be as indicated.
 - 4. Contact blocks used in heavy duty oil-tight control stations shall be Square D Type K single-pole, single-throw (SPST) or single-pole, double-throw (SPDT) and shall be suitable for mounting side by side and/or in tandem to the base of the operator. Contact block mounting screws shall be captive with a drilled and tapped head to permit easy tandem mounting of contact blocks. Terminals shall

be pressure wire type with a self-lifting pressure clamp that will compensate for wire of different size ranging from #12-#18 solid or stranded. Contacts shall be double break. Contact tips shall be silver.

- C. All equipment and devices shall be rated for space where being installed.
- D. Acceptable manufactures are Allen Bradley, Square D, or Cutler Hammer, equal.

2.34 MOTOR CONTROL CENTER

A. General

1. Motor Control Center(s) shall be Square D, Cutler-Hammer Freedom Series 2100 Design, GE(ABB) or Siemens. Motor Control Center(s) shall have been tested in a high-power laboratory to provide adequate mechanical and electrical capabilities. All major components shall have been individually design tested and guaranteed by the manufacturer. Wiring shall be NEMA Class 2B+2S. MCC wiring diagrams shall show all remote devices indicated on Contract Drawings.
2. The type of enclosure shall be in accordance with NEMA Standards for Type 1A with gasketed doors. All enclosing sheet steel, wireways and unit doors shall be gasketed.
3. The Motor Control Center shall be 600 volt class suitable for operation on a three phase, 60 Hertz system. The system operating voltage and number of wires shall be as indicated on the drawings.
4. Equipment shall meet the applicable NEMA, ANSI and UL standards.
5. The contract drawings have provided detailed customized schematic wiring diagrams for all motor control center equipment as well as individual wall mounted starters, control panels, etc. These are very detailed and a lot of effort has been expended to compile these diagrams. The equipment manufacturer/supplier of this equipment as specified shall be responsible to provide the following detailed and customized schematic wiring diagrams:
 - a. A separate customized and detailed schematic for each piece of equipment (i.e. RAS pumps No. 1, No. 2 and No. 3). Even though the schematic appears to be the same for this equipment a separate schematic for each will be provided with the referenced title (i.e. RAS Pump No. 1, etc.) noted on the respective schematic.
 - b. Each schematic shall indicate and show the specific devices (hand-off-auto, run light, ETM, etc.) and a reference to where this is located.
 - c. All contacts and interlocks shall be identified as to their location.
 - d. All metering and interface devices such as digital metering, TVSS, lightning protection, etc., shall be shown, identified, and dimensional heights from bottom of equipment shall be noted.
6. Failure to provide the proper customized schematic wiring diagrams shall be grounds for automatic rejection. Any delays, scheduling issues, and additional contract time and cost associated with delays due to equipment not being reviewed or being rejected for these reasons shall be the responsibility of the Contractor.

B. Structure Arrangement

1. Structures shall be totally enclosed deadfront, free standing assemblies. They shall be 90 inches high and 20 inches minimum/21 inches maximum depth for

front mounted and back-to-back units. Structures shall contain a horizontal wireway at the top, isolated from the horizontal bus and shall be readily accessible through a hinged cover. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference.

2. Compartments for mounting control units shall be incrementally arranged such that not more than six size 1 starters can be mounted within each vertical structure. Guide rails shall be provided.
3. A vertical wireway with minimum of 35 square inches of cross sectional area shall be adjacent to each vertical unit and shall be covered by a hinged door. Wireways shall contain steel rod cable supports.

C. Bus Arrangement

1. Each structure shall contain a main horizontal copper bus, with minimum ampacity as shown on the drawings. Vertical busses feeding unit compartments shall be copper and shall be securely bolted to the horizontal main bus. All joints shall be front accessible for ease of maintenance. The vertical bus shall have a minimum rating of 300 amperes for front mounted units.
2. The vertical bus shall be completely isolated and insulated by means of a labyrinth design barrier. It shall effectively isolate the vertical busses to prevent any fault generated gasses to pass from one phase to another.
3. Busses shall be braced for 65,000 amperes rms symmetrical (minimum), or as shown on drawings.

D. Unit Construction

1. All full voltage starter units through NEMA size 5 shall be of the draw out type. Draw out provisions shall include a positive guide rail system and stab shrouds to absolutely ensure alignment of stabs with the vertical bus. Drawout units shall have a tin-plated stab assembly for connection to the vertical bus. No wiring to these stabs shall extend into the bus compartment. Interior of all units shall be painted white for increased visibility. Units shall be equipped with side-mounted, pressure pull-apart type control terminal blocks rated 480 volts. Knockouts shall be provided for the additional of future terminal blocks.
2. All drawout units shall be secured by a spring loaded quarter turn indicating type fastening device located at the top front of the unit. Each unit compartment shall be provided with an individual front door.
3. An operating mechanism shall be mounted on the primary disconnect of each starter unit. It shall be mechanically interlocked with the unit door to prevent access unless the disconnect is in the OFF position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. A second interlock shall be provided to prevent removal or re-insertion of the unit while in the ON position. Padlocking facilities shall be provided to positively lock the disconnect in the OFF position with from one to three padlocks with the door open or closed. In addition, means shall be provided to padlock the unit in a partially withdrawn position with the stabs free of the vertical bus.
4. Combination starter units shall be full voltage non-reversing, unless shown otherwise, and shall utilize Motor Circuit Protectors Type HMCP. Each combination unit shall be rated 65,000 AIC symmetrical at 480V. The HMCP

shall provide adjustable magnetic protection and be provided with pin insert to stop the magnetic adjustment at 1300% motor nameplate full load current to comply with NEC requirements. All HMCP combination starter units shall have a "tripped" position on the unit disconnect and a push-to-test button on the HMCP. Type HMCP motor circuit protectors shall include transient override feature for motor inrush current.

5. Linestarters shall be electrically operated, electrically held, three pole assemblies with arc extinguishing characteristics and shall have silver-to-silver renewable contacts. They shall have provisions for a total of eight NO or eight NC auxiliary contacts. The overload relay assembly shall be of the thermal bimetallic type. Overload relays shall be reset from outside the enclosure by means of an insulated button. The overload relay shall have a built-in push-to-test button.
 6. Each starter shall be equipped with a fused control power transformer, two indicating lights, and two NO and two NC contacts, unless otherwise scheduled on the drawings. Device panel to have space to accommodate six oil-tight pilot-control devices or indicating ammeters, voltmeters, or elapsed time meters.
 7. Indicating lights shall be 120V, 30mm, LED type, Push to Test type.
 8. Individual feeder breakers shall have a minimum interrupting capacity of 65,000 AIC or as scheduled on the drawings.
- E. Finish
1. The control center shall be given a phosphatizing pretreatment. The paint finish shall be an anionic, thermoset acrylic. Manufacturer's standard color shall be used.
- F. Nameplates
1. Each unit will have 1.0 x 2.5 inch hot stamped nameplate. The lettering shall be white 3/16 inch high, in a black background.
- G. Lightning Arresters and Surge Capacitors
1. Provide lightning arrestors and surge capacitors as shown on contract drawings.
- H. Power Meter
1. Provide microprocessor metering as shown on the drawings for power metering and loss of normal power monitoring. Metering shall be Allen-Bradley 1404 Power Monitor 3000 or equivalent with the following:
 - a. #1404-DMA display
 - b. #1404-NENET (Ethernet) communication card
 - c. Output contact for alarm of Normal Power Loss
 2. Also provide a TVSS and a circuit breaker sized as shown on drawing.
 3. Power meter shall be installed at a visible height not to exceed 6'-5".

2.35 ELECTRICAL HAND HOLES

- A. Electrical hand holes shall be Composolite as manufactured by Strongwell Corporation or equivalent. Precast concrete hand holes as detailed on the Drawings shall also be acceptable. Hand holes shall be sized per the N.E.C. according to number and sizes of entering conduits. All hand holes shall be rated for H2O wheel loading. Separate hand holes and conduit systems shall be provided for power, control, and instrumentation systems.

2.36 FINAL AS-BUILT RECORD DRAWINGS

- A. During the ongoing construction the contractor shall maintain a clean set of full size drawings for markup. The drawings shall be red lined and marked up with all appropriately noted changes noting the as-built condition. Upon completion of the project the set of as-built markups shall be provided to the Engineer for final AutoCAD revisions.

2.37 COMPLETE ELECTRICAL DISTRIBUTION EQUIPMENT SUPPLIER

- A. All electrical distribution equipment submitted for this project shall be by a single equipment manufacturer. Multiple suppliers of this equipment shall not be acceptable. The following manufactures shall be acceptable:
 - 1. Square D Company
 - 2. Cutler-Hammer
 - 3. Siemens
 - 4. GE(ABB)

2.38 TEMPORARY POWER REQUIREMENT USING PORTABLE GENERATOR

- A. The specification requirements have been noted the contractor's responsibility for maintaining the pump stations operational at all times for the duration of the project. This shall be served via a portable generator provided by the contractor during times of the replacement of the electrical service upgrade as shown and specified.
- B. The use of a portable generator for temporary power must meet the dBA requirements of the respective city or town where the work is to be performed when in use during all periods of operation.
- C. All permits required for this application shall be the complete responsibility of the contractor.

2.39 EXOTHERMIC CONNECTION

- A. The contractor shall be responsible to furnish and install exothermic connections as required and shown on the contract drawings.
- B. The mold shall be new and clean and shall provide all required connection molds for different required types.
- C. All connections shall be industry standards in a complete, continuous, and properly installed connection. Any connections not properly installed as inspected shall be removed and re-formed at the contractor's expense.

PART 3 - INSTALLATION

3.1 RACEWAYS AND FITTINGS

- A. Unless otherwise indicated on the Drawings, install all wiring in the following applicable raceway system:
 - 1. Wiring above 600 volts in indoor dry locations (NEMA 12): Heavywall aluminum conduit or cable tray (indoor only). Galvanized heavy duty rigid steel conduit with no exceptions by the Engineer.
 - 2. Wiring 600 volts or less in dry concealed locations (NEMA 12): Galvanized electrical metallic tubing (for raceway sizes up to and including 2" trade size)

- or galvanized rigid heavy wall steel conduit. Only to be used in above ceiling spaces or within block walls or stud walls.
3. Wiring 600 volts or less in outdoor, above grade locations (NEMA 4X): PVC coated galvanized rigid heavy wall steel conduit with no exceptions by the Engineer.
 4. Wiring 600 volts or less in indoor wet locations (NEMA 4X): Rigid heavy wall aluminum conduit. Galvanized rigid heavy wall steel conduit with no exceptions by the Engineer.
 5. Wiring 600 volts or less in indoor or outdoor corrosive chemical areas use PVC-coated rigid steel conduit.
 6. Wiring 600 volts or less in hazardous locations (NEMA 7 or 9): Galvanized rigid heavy wall steel conduit, PVC galvanized rigid steel conduit, or rigid heavy wall aluminum conduit based on requirements listed previously in this section.
 7. Underground Raceways
 - a. All underground raceways shall be Schedule 80 extra heavy wall PVC conduit except for signal conduit raceways which shall be rigid steel conduit.
 - b. Refer to drawings for specific concrete encasement duct bank details and requirements. All underground duct banks shall be completely concrete encased. Schedule 40 PVC allowed for conduit runs other than Signal conduits.
- B. Where conduit extends out from underground or enters a structure/building or utility pole, it shall be installed as galvanized rigid steel conduit. This shall remain galvanized rigid steel to its final destination.
- C. Where conduits are installed concealed within or below concrete slab within the generator building and extend up through the slab galvanized rigid steel conduit sweeps shall be installed at all locations and shall remain galvanized rigid steel conduit for all exposed areas.
- D. Armored metal clad cable (MC) shall be allowed to be used for receptacles and switches which may be installed within studded walls. EMT shall also be allowed to be used in this application also.
- E. MC cable whips no longer than 3 feet only can be used for drop feeds to light fixtures up in attic area.
- F. No wire shall be pulled until the raceway system is complete in all details.
- G. The ends of all raceways shall be tightly capped to exclude dust and moisture during the construction period. Caps shall be of a UL Listed type specifically used for this purpose. Rags, papers, etc. shall not be used.
- H. Raceways terminating in gasketed enclosures shall be terminated with conduit hubs.
- I. Raceways installed underground shall be encased in concrete and laid on trenches on mats of bank gravel or sand not less than six inch thick and well graded.
- J. Provide long radius rigid steel conduit sweeps at entrances to equipment from underground.
- K. Provide conduit expansion fittings as required. Install per manufacturers recommendation.

3.2 WIRES AND CABLES

- A. All conductors shall be carefully handled to avoid kinks or damage to insulation.
- B. Alarm wires shall be uniquely identified at each end with wire markers. A typed list of the numbers used and their function (alarm served) shall be submitted to the Engineer by the Contractor.
- C. All 600 Volt wire insulation shall be tested with a megohm meter after installation. Tests shall be made at not less than 500 Volts. A written test report of the results shall be submitted to the Engineer by the Contractor.
- D. After installation of service conductors seal conduits in pump station with duct seal.
- E. Grouping of Conductors
 - 1. Contractor may group certain wiring with the approval of the Engineer, as follows.
 - a. Power 120V may be grouped with power 120V
 - b. Control 120V may be grouped with control 120V
 - c. Control 24V may be grouped with control 24V
 - d. Instrumentation may be grouped with instrumentation
 - e. Specialty wiring may be grouped with like systems
 - f. Power wiring at 480V shall not be grouped
 - g. Fire alarm system wiring shall not be grouped with other systems

The installation shall be installed in accordance with all requirements of the NEC (including wire ampacity derating factors), manufacturer's requirements, and the Engineer. Excessive grouping which interferes with functionality and reliability will not be allowed. The wiring configuration as shown on the drawings is the baseline requirement for the work.

3.3 GROUNDING

- A. Provide grounding conductors from ground electrodes to equipment as shown on the Drawings.
- B. Do not use conduit as the ground and/or bonding conductor.
- C. Bond ground terminal of receptacles to outlet boxes with #12 AWG green insulated wire.
- D. Ground conduit system and neutral conductor of wiring system with a connection at the main electrical service breaker.
- E. The grounding network shall be connected to metallic water piping system, at two or more locations, with stranded copper, AWG, Green Insulated Conductor of the same size as grounding electrode conductor shown on the drawings or required by the National Electrical Code (NEC).
- F. Make connections to ground rods with an exothermic welding process. Mechanical connections may be made at equipment only.
- G. Ensure that a ground loop is not formed between equipment ground in electrical conduit and grounding electrode conductors directly connected to ground electrodes.
- H. Group and bond ground wires to panel boxes, light fixtures, receptacles, etc., not to system neutral.
- I. Make connection to water pipe with a suitable ground clamp or lug connection. If flanged pipes are encountered, make connection with lug bolted to flange connections.

- J. Bond and ground all conduit systems.

3.4 EQUIPMENT

- A. The inside of all equipment and enclosures shall be checked for tools and vacuumed cleaned of any debris.
- B. The Contractor shall be responsible to ensure that all connections to motors, distribution equipment, and control panels are tightened to manufactures recommendations.

3.5 TESTS

- A. The entire grounding network resistance to be meggered and certified results recorded and submitted with no exceptions to the Engineer. Resistance shall not exceed 25 Ohms.
- B. Branch circuits shall be tested during installation for continuity and identification and shall pass operational tests to determine that all circuits perform the function for which they are designed.
- C. Adjust all settings on protective equipment and verify, check and establish with the power company that the secondary voltage is within 2% of rated voltage.
- D. Test and set all motor circuit protectors, motor overload heaters to the nameplate horsepower of the equipment; and all circuit breaker settings in all electrical equipment shall be tested and verified operational.
- E. Three phase panelboard's line currents shall be balanced to within 10% of each other.
- F. For all feeder wiring rated 600 volts or less, provide 1,000 volt "Megger" insulation test prior to energizing feeders. Use a motor-driven megger for all tests. Test voltage shall be applied until readings reach a constant value, and until three (3) equal readings, each one (1) minute apart, are obtained. Minimum megger reading shall be 45 megohms for feeder conductors. Document test results and submit to engineer. There shall be no exceptions taken by the Engineer before conductors are to be energized. See attached table at end of this section for recording data and submission to the Engineer.
- G. Three phase motors shall be checked for rotation and, if necessary, reverse the connections at the starter. Single phase and DC motors at motor connection box.
- H. VFD START UP, TESTING AND VERIFICATION
 - 1. Responsibility and Coordination: The VFD manufacture, supplier and electrical subcontractor are responsible for adjusting all of the VFD parameters for a fully functional system integrated with the instrumentation and control systems for this project. The VFD supplier and electrical subcontractor are responsible for coordinating with the instrumentation subcontractor and the instrumentation programmer so the control systems function as intended as described in the instrumentation control descriptions.
 - 2. VFD Parameter Setup: Complete the VFD Parameter Setup Checklist and Verification below in the presence of the specifying engineer.
 - 3. The electrical subcontractor shall be responsible to coordinate an onsite meeting with the VFD manufacturers technician and the specifying engineer. This meeting shall take place prior to the initial startup of the equipment.

VFD PARAMETER SETUP CHECKLIST

[ENTER NAME OF FACILITY]

- ☐ 1. Ramp up speed _____
- ☐ 2. Ramp down speed _____
- ☐ 3. Min speed (Hz) _____
- ☐ 4. Max speed (Hz) _____
- ☐ 5. 4-20mA setting at min speed (mA) _____
- ☐ 6. 4-20mA setting at max speed (mA) _____
- ☐ 7. Output scale calibration _____
- ☐ 8. Auto restart after power failure (yes/no) _____
- ☐ 9. Auto restart after overcurrent fault (yes/no) _____
- ☐ 10. Speed reference (internal/external) _____
- ☐ 11. If external - signal source _____
- ☐ 12. If external - signal type _____
- ☐ 13. Restart after E-Stop (yes/no) _____
- ☐ 14. Discrete outputs - Run (yes/no) _____
- ☐ 15. Discrete outputs - Fault (yes/no) _____
- ☐ 16. Analog outputs - Amps (absolute units) _____
- ☐ 17. Analog outputs - KW (absolute units) _____
- ☐ 18. Analog outputs - Speed (Hz) _____
- ☐ 19. Analog outputs - Speed (RPM) _____
- ☐ 20. Analog inputs - 4mA set to 0Hz (yes/no) _____
- ☐ 21. Analog inputs - 20mA set to 60Hz (yes/no) _____
- ☐ 22. Analog inputs - min speed limit set (yes/no) _____
- ☐ 23. Analog inputs - max speed limit set (yes/no) _____
- ☐ 24. Voltage boost (%) _____
- ☐ 25. Starting frequency (Hz) _____
- ☐ 26. PMW carrier frequency (Hz) _____
- ☐ 27. Acceleration time (sec) _____
- ☐ 28. Deceleration time (sec) _____
- ☐ 29. Forward run (yes/no) _____
- ☐ 30. Reverse run (yes/no) _____
- ☐ 31. Overload (60%-100%) _____

VFD PARAMETER SETUP VERIFICATION

[ENTER NAME OF FACILITY]

Date: _____

General Contractor: _____

Electrical
Subcontractor: _____

VFD Supplier: _____

This certifies that the VFD parameters have been coordinated per the specifications and the requirements of this section.

(Authorized Representative of the General Contractor)

Date

(Authorized Representative of the Electrical Subcontractor)

Date

(Authorized Representative of the VFD Supplier)

Date

PUMP STATION "NAME"
MEGGER TEST RESULTS

Project: _____ **Temperature:** _____
Date: _____ **Weather:** _____
Location: _____ **Test Equipment:** _____

Equipment / Feeder Under Test: _____ **Start Time:** _____ **End Time:** _____

Test Equipment: Make: _____ **Serial No.:** _____ **Test Voltage:** _____

	0.5 min	1 min	2 min	3 min	4 min	5 min	6 min	7 min	8 min	9 min	10 min	P.I.
ΦA-Gnd.												
ΦB-Gnd.												
ΦC-Gnd.												
ΦA-ΦB												
ΦA-ΦC												
ΦB-ΦC.												

Equipment / Feeder Under Test: _____ **Start Time:** _____ **End Time:** _____

	0.5 min	1 min	2 min	3 min	4 min	5 min	6 min	7 min	8 min	9 min	10 min	P.I.
ΦA-Gnd.												
ΦB-Gnd.												
ΦC-Gnd.												
NEUT -Gnd.												
ΦA-ΦB												
ΦA-ΦC												
ΦB-ΦC.												

Notes: *Megger test only should record 5 minute value*
Polarization Index (P.I.) is 10 min reading divided by 1 min reading

END OF SECTION

SECTION 16500

LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide complete interior and exterior lighting systems, including fixtures, standards, poles, hangers, supports, fittings, lamps, wiring, connections and controls, as indicated in the Contract Documents.
- B. The lighting layouts on the DRAWINGS are diagrammatic only. Lighting fixtures, in general, have been specified for the particular type of ceiling in which they are to be installed. Refer to Architectural "Reflected Ceiling Plans" for exact location of recessed interior fixtures. Verify the ceiling construction details and provide fixtures and mounting hardware suitable for the respective ceiling types.
- C. Manufacturer's lighting fixture catalog numbers as indicated on the "Lighting Fixture Schedule" indicate quality, type, efficiency and style but may not cover special, required design details. Provide lighting fixtures having such special details as noted in the "Lighting Fixture Schedule" and as required for proper installation.
- D. Verify the availability of all fixtures proposed to be used in the execution of the work prior to submitting same for the Engineer's review. The discontinuance of production of any fixture after such review shall not relieve the Contractor from furnishing an alternate fixture of equivalent quality and design without additional cost to the Owner.

1.2 QUALITY ASSURANCE

- A. All fixtures shall be new and shall bear the U.L. label for the service and location intended.
- B. Lighting fixtures shall be standard products of manufacturer regularly engaged in the manufacture of the specific type lighting fixture specified as one of their principal products and shall be the manufacturer's latest standard design that complies with the specification requirements.
- C. Lighting fixtures shall be as specified in the "Lighting Fixture Schedule" as shown on the contract drawings. Although only one manufacturer has been named, the phrase "or equal" may be applied to each fixture listed, unless otherwise noted. The lighting design is intended to be of the highest electrical efficiency and fixtures have been selected to provide the best illumination, at the lowest life cycle cost. The Engineer reserves the right to disapprove any lamp or fixture type submitted which is, in the Engineer's opinion, not equal in quality, appearance, efficiency or performance to the fixture specified.

1.3 SUBMITTALS TO THE ENGINEER

- A. Shop Drawings are required for all items provided under this section. Submittals shall be provided in accordance with Sections 01340, 16000 and as specified in this section.
- B. All lighting fixture types shall be submitted in a single complete brochure which shall be in the form of a hard cover binder with each fixture separated by an identified index tab. Catalog cut sheets shall indicate fixture identification, i.e., type A, D, J,

etc., and shall indicate where it will be used. Information on each fixture shall include:

1. Manufacturer and Catalog Number
2. Dimensioned Construction Drawing(s)
3. Standard Catalog "Cut" Sheet modified to show any options/accessories to be provided
4. Photometrics of each fixture
5. Lens/Louver Type for each fixture
6. Power Requirements
7. Ballast Type, Quantity and Rating
8. Socket Type/Position
9. Lamp Type, Quantity and specifications
10. Mounting Type and details of mounting equipment
11. Lighting Occupancy Sensors / Controls
12. Interior Lighting Control Panel (ILCP), controls and wiring diagrams
13. Exterior Lighting Control Panel (ELCP), controls and wiring diagrams
14. Exterior Lighting Poles and Hardware
15. Exterior Pole Bases

1.4 DELIVERY, STORAGE AND HANDLING

- A. Refer to Specification 16000.

PART 2 - PRODUCT

2.1 MATERIALS

- A. Fixtures shall be identical in construction features, options and appearance to the fixtures specified in the Lighting Fixture Schedule as shown on the contract drawings. All fixtures shall be able to be pendant mounted.
- B. Lamps
 1. Lamps shall be LED, suitable for long life operation.
 2. Acceptable Lamp Manufacturers: General Electric, Osram/Sylvania, Phillips or approved equal.
- C. Emergency Lighting System (12 VDC System)
 1. Power Units
 - a. Dry locations:
 - i. Each power unit shall be commercial grade, UL listed, completely self-contained and consist of twin lighting heads (where indicated on the Drawings) mounted on multi-directional swivels.
 - ii. Shall be furnished with a sealed, maintenance-free, nickel cadmium battery.
 - iii. Shall be furnished with a solid state fully automatic, voltage limited battery charger with solid state switching, brownout sensitivity, low voltage battery disconnect and overload/short circuit protection.
 - iv. Each battery shall be capable of supplying power to the unit lights and all connected remote fixtures for a period of 90 minutes per NEC, to an end voltage of 87.5% of nominal battery voltage.
 - v. The unit shall contain an AC "ON" light, high charge pilot light, and

- test switch to check transfer to DC lamps.
- vi. Unit shall mount on standard 4 inch octagonal or square outlet box.
- vii. Each lamp shall be LED.
- viii. Remote heads shall be flame and impact resistant thermoplastic lampholders. Lamps shall be LED.
- b. Wet Locations:
 - i. Each power unit shall be commercial grade, UL wet location listed, completely self-contained and consist of twin lighting heads (where indicated on the Drawings) mounted on multi-directional swivels.
 - ii. Each unit shall be furnished with a sealed, maintenance-free, nickel cadmium battery.
 - iii. Each unit shall be furnished with a solid state fully automatic, voltage limited battery charger with solid state switching, brownout sensitivity, low voltage battery disconnect and overload/short circuit protection.
 - iv. Each battery shall be capable of supplying power to the unit lights and all connected remote fixtures for a period of 90 minutes per NEC, to an end voltage of 87.5% of nominal battery voltage.
 - v. Lights shall be provided which form an integral part of the component chassis.
 - vi. The power unit shall be in a watertight, corrosion resistant, NEMA 4X housing.
 - vii. The housing shall contain an AC "ON" light, high charge pilot light, and test switch to check transfer to DC lamps.
 - viii. The unit shall mount on standard 4 inch octagonal or square outlet box.
 - ix. Each lamp shall be LED.
 - x. Remote heads shall be flame and impact resistant thermoplastic lampholders suitable for use in wet locations.
 - xi. Lamps shall be LED.
- c. Hazardous Locations:
 - i. Where possible, or as shown on the Contract Drawings, provide and locate a suitably rated battery unit without lighting heads in a non-classified environment to power remote (Class I, Div. 1) lighting heads.
 - ii. The lighting head(s) shall be rated for the Class I, Div. 1 environment as specified below.
 - iii. Each power unit shall be commercial grade, UL listed for use in Class I, Division 1, Group C & D locations, completely self-contained and consist of twin lighting heads (where indicated on the Drawings);
 - iv. Each unit shall be furnished with a sealed, maintenance-free, nickel cadmium battery.
 - v. Each unit shall be furnished with solid state fully automatic, voltage limited battery charger with solid state switching, brownout sensitivity, low voltage battery disconnect and overload/short circuit

- protection.
- vi. Each battery shall be capable of supplying power to the unit lights and all connected remote fixtures for a period of 90 minutes per NEC, to an end voltage of 87.5% of nominal battery voltage.
 - vii. The power unit and lighting heads shall be in a NEMA 7/9 copper-free aluminum housing with hinged cover and neoprene gasket.
 - viii. A pilot light, and test switch to check transfer to DC lamps shall be located adjacent to the power unit connected with approved fittings for the area.
 - ix. The power unit shall contain a one-way breather and drain.
 - x. Each lamp housing shall be constructed of copper-free aluminum with aluminum guard and pendant style mounting for both unit and/or remote mounting.
 - xi. Lamps shall be 12V DC medium base A-lamp, 15W.
2. Exit Signs:
- a. Dry Locations
 - i. Exit sign light fixtures shall be of the self-powered LED type, constructed of high impact polycarbonate material, and shall normally be powered by 120-277V AC.
 - ii. Each unit shall have a solid state fully automatic, voltage limited battery charger with the following:
 - (1) solid state switching
 - (2) brownout sensitivity
 - (3) low voltage battery disconnect and overload/short circuit protection
 - (4) test switch and power indicator light
 - iii. The battery shall be sealed, maintenance-free, nickel cadmium battery.
 - iv. Fixtures shall have 6-inch high red lettering with aluminum stencil face and matte black housing.
 - b. Wet Locations
 - i. Exit light fixtures shall be of the self-powered LED type, constructed of die-cast aluminum material, and shall normally be powered by 120-277V AC.
 - ii. The shield shall be constructed of injection molded, clear polycarbonate material to protect against moisture, rain, dust and vandalism.
 - iii. The fixture shall be UL listed and labeled as being suitable for use in wet and corrosive environments.
 - iv. Each unit shall have a solid state fully automatic, voltage limited battery charger with the following
 - (1) solid state switching, brownout sensitivity
 - (2) low voltage battery disconnect and overload/short circuit protection
 - (3) test switch and power indicator light
 - v. The battery shall be sealed, maintenance-free, nickel cadmium

- battery.
- vi. The fixture shall be self diagnostic with photocell testing. Testing shall be accomplished using a laser pointer. A minimum of one laser pointer shall be supplied for the project.
- vii. Fixtures shall have 6-inch high red lettering with aluminum stencil face and matte black housing.
- c. Hazardous Locations
 - i. Exit lighting fixture shall be factory sealed with housing constructed of copper free aluminum and faceplate being constructed of impact resistant acrylic with 6-inch high red letters.
 - ii. Two 60 watt, LED lamps shall be utilized to illuminate the sign. Unit shall be UL listed for use in Class I, Division 1, Groups C and D Locations.
- D. Exterior Lighting Control Panels (ELCP)
 - 1. The control panel shall operate on 120-277 volts and be U.L. Listed and Labeled as a complete assembly.
 - 2. Shall be furnished with a main circuit breaker.
 - 3. NEMA rating of control panels shall be based on the areas in which they are installed. Refer to Drawing E-1 for the NEMA classifications for Electrical Equipment and Enclosures.
 - 4. For enclosure construction information refer to specification 16160.
 - 5. For control equipment (i.e. contactors, selector switches, etc.) refer to specifications 16050 and 16900.
 - 6. Refer to schematic diagrams on the contract drawings for description of operation and control equipment required for the exterior lighting.
 - 7. Provide individual device and panel labeling as required by the contract drawings and specification 16010.
 - 8. All components of the lighting control panel, contactors, relays, switches, indicating lights, etc., as required by the contract drawings shall be submitted under this specification as a complete and operational lighting control system.
- E. Fixture Supports and Hangers
 - 1. Provide all necessary mounting brackets and boxes, suitable for the area in which it is to be installed, as required for a complete functioning installation for all lighting for project.
 - 2. Provide all necessary hangers and supports for proper fixture installation.
 - 3. Fixture supports shall be capable of supporting a minimum of two and one-half times the load normally carried at point of support.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to the contract documents for fixture mounting heights.
- B. Mount fixtures in true vertical and horizontal alignment.
- C. Fixture locations shown on the drawings are diagrammatic only. They are shown for quantity and approximate locations only. Adjust the location of any lighting fixture as required to avoid interferences with existing conditions, equipment, and of the work of other trades.

- D. Each fixture provided shall be a completely finished unit with all components, mounting and/or hanging devices necessary for the proper installation of the particular fixture.
- E. Mount all emergency lighting, exit signs, and light fixtures as indicated on the contract drawings when possible.
- F. Ground all lighting fixtures and lighting poles per the National Electric Code, Article 250, as shown on drawings, and specification 16450.
- G. Hangers and supports shall be anchored to channels in the ceiling construction, to the structural slab or to structural members above the suspended ceiling.
- H. Fixtures mounted in suspended "lay-in" ceilings shall be supported from inverted "tee-bars" using "Caddy" clips suitable for the fixture type installed.
- I. All suspended fixtures shall be pendant mounted and be suspended from the ceiling using cast swivel type connectors and 3/4 inch rigid galvanized steel conduit minimum, unless otherwise specified by the fixture manufacturer.
- J. Provide all necessary accessories for "end-to-end" mounting where continuous rows of fixtures are indicated.
- K. Coordinate all recessed fixtures with the ceiling grid system prior to installation of the ceiling grid system where applicable. Lighting fixtures and mounting shall be compatible with the ceiling grid system.
- L. Where multiple switching of fixtures is indicated, the outside two (2) lamps of each fixture in the controlled area shall be switched separately from the interior (center) lamp(s).
- M. Adjust as necessary any occupancy sensor for the automatic lighting controls such that all areas in the space being luminated is covered.
- N. Install Exterior Lighting Control Panel at an accessible height for convenient access and operation.
- O. Interior Lighting Control Panel:
 - 1. Install Interior Lighting Control Panel at an accessible height for convenient access and operation.
 - 2. Lighting occupancy sensor shall be located and mounted as recommended by the equipment manufacturer.
 - 3. Position and adjust occupancy sensors as required for optional performance.
- P. Underwater Tank Lighting
 - 1. Install underwater tank lighting fixtures as shown on the contract drawings.
 - 2. Location (elevation) and Installation of the tank lighting fixture shall be in strict accordance with the NEC and the manufacturer's recommendations.
 - 3. Provide all required grounding (#8 AWG min.) of the fixture as recommended by the manufacturer.
 - 4. Provide a ground fault circuit interrupter and appropriately sized circuit breaker as recommended by the manufacturer.
 - 5. Provide and install a timer for the lighting circuit as shown on the contract drawings.
- Q. Foundations for exterior lighting standards shall be as detailed on the DRAWINGS. Anchor bolts shall be of minimum diameter and length as shown, four (4) per standard, and installed per the pole manufacturer's pole base requirements. Foundations shall be formed of concrete of 4000 psi minimum compressive strength

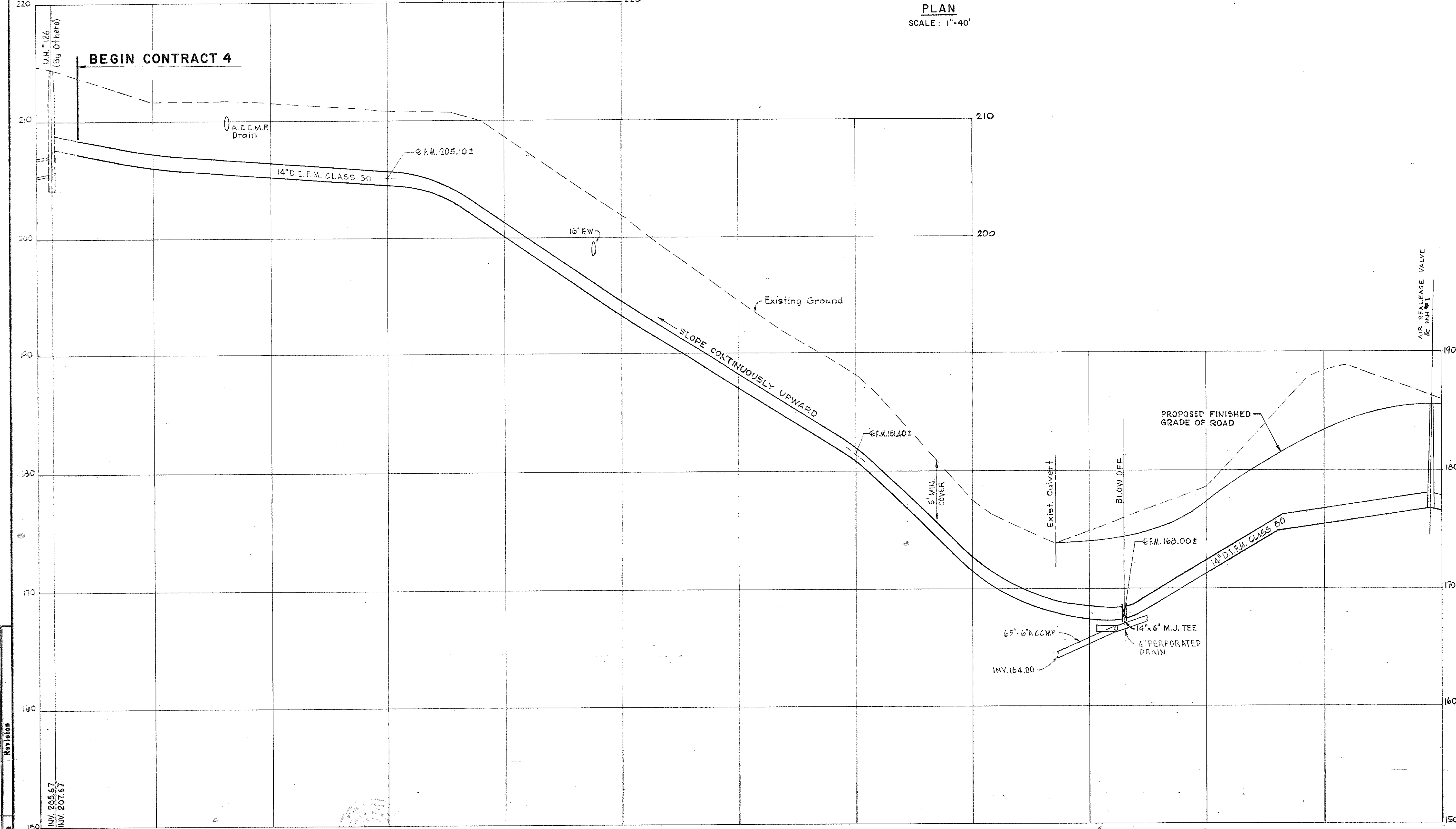
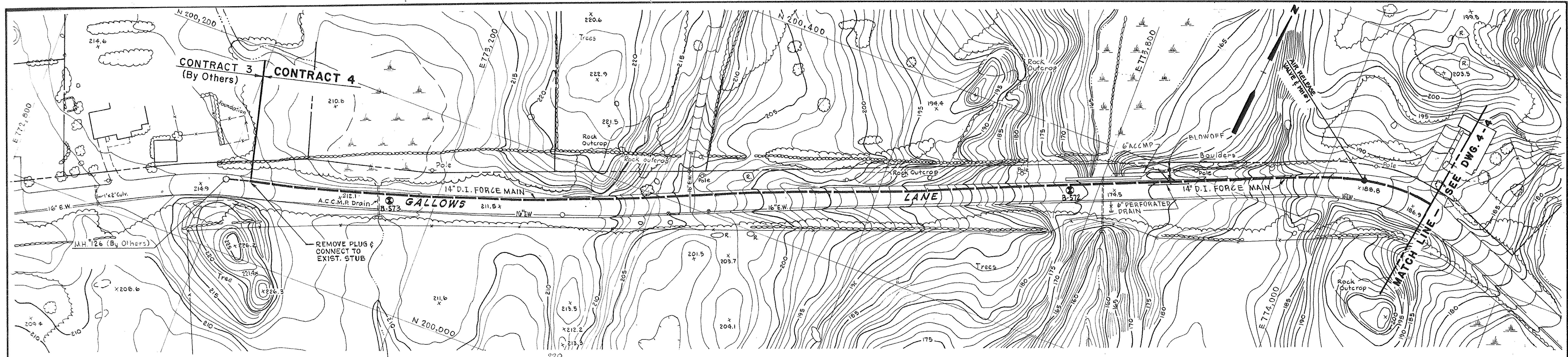
at 28 days. All corners of foundations above grade shall be chamfered 1 inch. Each foundation shall be equipped with galvanized rigid conduit elbows and nipples of appropriate length to connect between pole base and under-ground wiring system. Provide grounding type bushings on each conduit.

- R. All wiring within exterior poles and luminaires shall be minimum No. 10 AWG copper with approved insulation.

END OF SECTION

Appendix A

Pump Station Force Main Drawings



PIPE NOTES:

GRAVITY SEWERS 12 INCHES AND SMALLER SHALL BE PVC PIPE.

GRAVITY SEWERS 16 INCHES AND LARGER SHALL BE RCC PIPE.

FORCE MAINS SHALL BE DUCTILE IRON PIPE, CLASS AS SHOWN.

WATER AND SEWER COMMISSION

WATERFORD CONNECTICUT

SEWAGE WORKS CONSTRUCTION PROGRAM

CONTRACT 4

QUAKER HILL INTERCEPTOR SEWER

GALLOWES LANE

14" FORCE MAIN

HAYDEN & HARDING

Consulting Engineers - Boston, Massachusetts 02135

SCALE: As Noted

DATE: JAN. 1978

69139

4-3

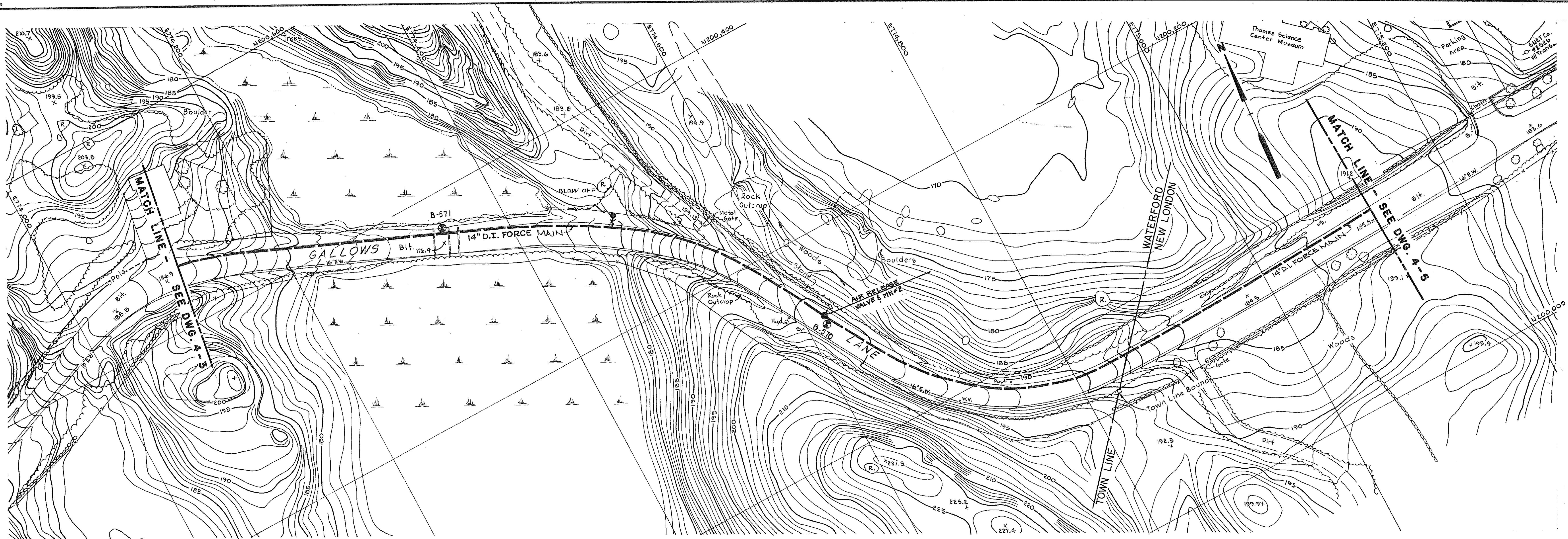
No.	Date	Revision
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2	NOV 207 67	2

RECORD DRAWING / APPROVED - CHIEF ENGINEER / DATE

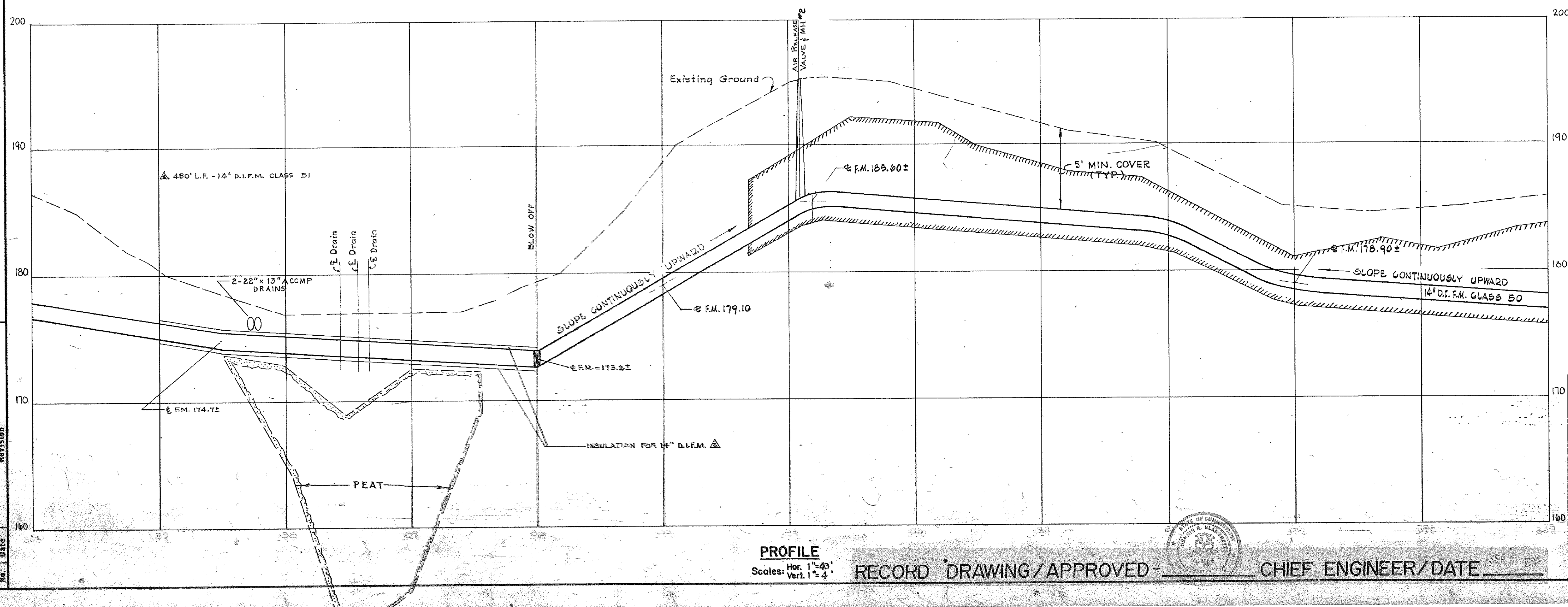
PROFILE

Scales: Hor. 1"=40'

Vert. 1"=4'



PLAN
SCALE: 1"=40'



PIPE NOTES:
GRAVITY SEWERS 12 INCHES AND SMALLER
SHALL BE PVC PIPE.
GRAVITY SEWERS 16 INCHES AND LARGER
SHALL BE RCC PIPE.
FORCE MAINS SHALL BE DUCTILE IRON PIPE,
CLASS AS SHOWN.

WATER AND SEWER COMMISSION
WATERFORD CONNECTICUT
SEWAGE WORKS CONSTRUCTION PROGRAM
CONTRACT 4

QUAKER HILL INTERCEPTOR SEWER
GALLOWS LANE
14" FORCE MAIN



HAYDEN & HARDING
Consulting Engineers - Boston, Massachusetts 02135
DRAWN: J.F.H.
DESIGNED: J.F.H.
CHECKED: E.N.N.
APPROVED: W.H.D.
SCALE: As Noted
DATE: JAN 1975
DRAWING: 4-4
69157

PROFILE
Scales: Hor. 1"=40',
Vert. 1"=4'

RECORD DRAWING / APPROVED -

CHIEF ENGINEER / DATE

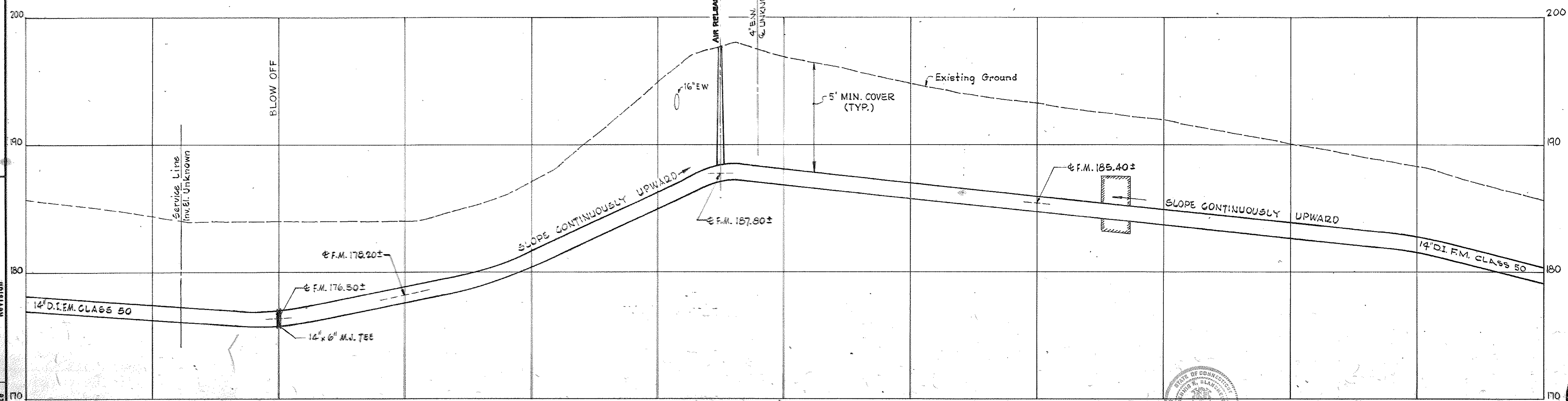
SEP 8 1982

4/81 As Built Corrections - DD

Revision
No. Date



PLAN
SCALE: 1" = 40'



PROFILE

Scales: Hor. 1" = 40'
Vert. 1" = 4'

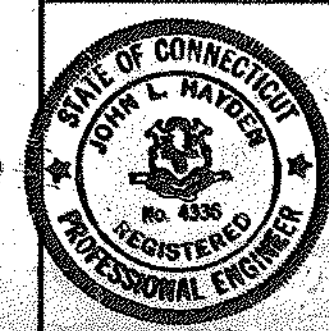
RECORD DRAWING / APPROVED -

CHIEF ENGINEER / DATE

PIPE NOTES:
GRAVITY SEWERS 12 INCHES AND SMALLER
SHALL BE PVC PIPE.
GRAVITY SEWERS 16 INCHES AND LARGER
SHALL BE RCC PIPE.
FORCE MAINS SHALL BE DUCTILE IRON PIPE,
CLASS AS SHOWN.

WATER AND SEWER COMMISSION
WATERFORD CONNECTICUT
SEWAGE WORKS CONSTRUCTION PROGRAM
CONTRACT 4

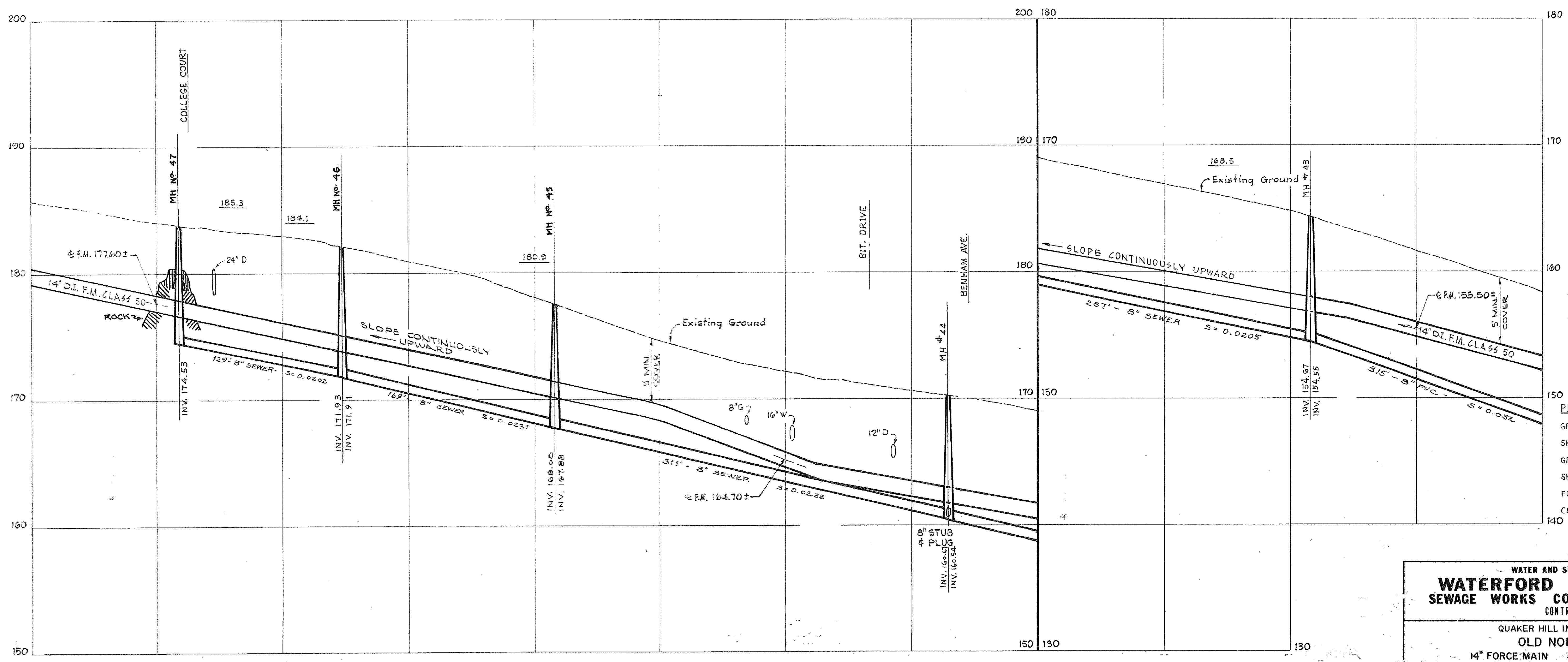
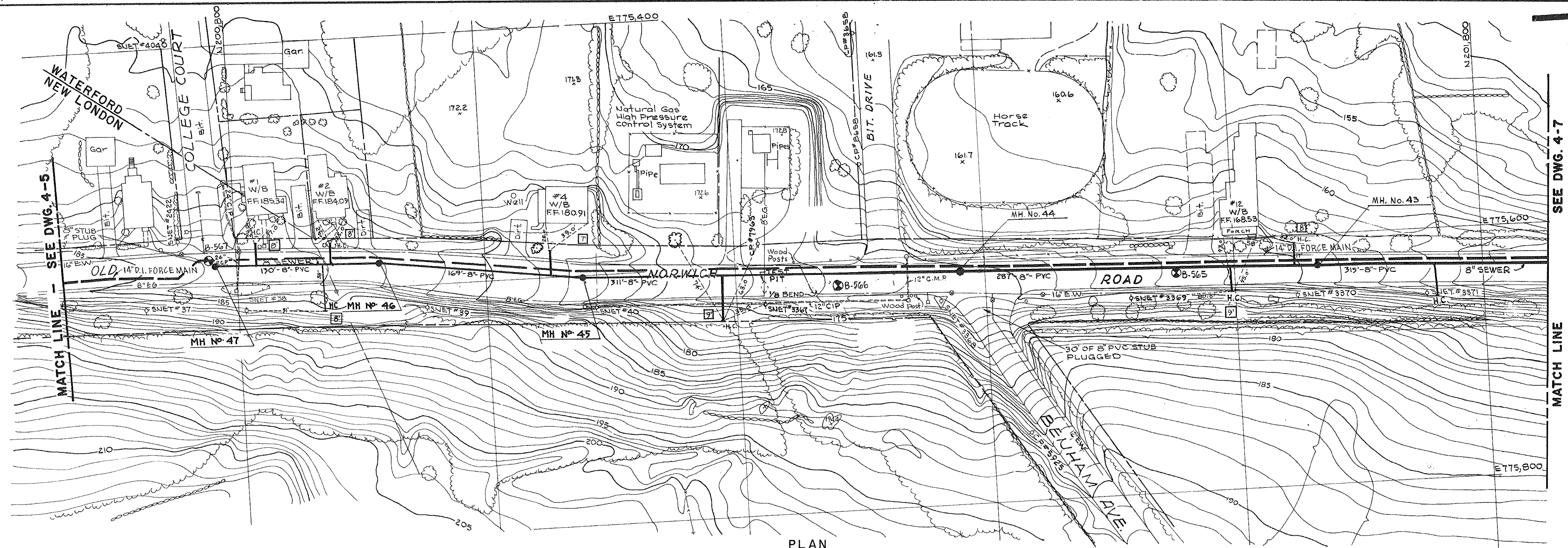
QUAKER HILL INTERCEPTOR SEWER
GALLOWS LANE - OLD NORWICH ROAD
14" FORCE MAIN



HAYDEN & HARDING
Consulting Engineers - Boston, Massachusetts 02135

DESIGNED: J.F.E.	SCALE: As Noted	DRAWING: 4-5
CHECKED: E.H.H.	DATE: JAN. 1973	
APPROVED: W.H.O.		

Rev.	Date	Description
1		As Built Corrections - DD



PIPE NOTES:
 GRAVITY SEWERS 12 INCHES AND SMALLER SHALL BE PVC PIPE.
 GRAVITY SEWERS 16 INCHES AND LARGER SHALL BE RCC PIPE.
 FORCE MAINS SHALL BE DUCTILE IRON PIPE, CLASS AS SHOWN.

WATER AND SEWER COMMISSION
WATERFORD CONNECTICUT
 SEWAGE WORKS CONSTRUCTION PROGRAM
 CONTRACT 4

QUAKER HILL INTERCEPTOR SEWER
 OLD NORWICH ROAD
 14" FORCE MAIN
 8" SEWER

HAYDEN & HARDING
 Consulting Engineers - Boston, Mass. 02135

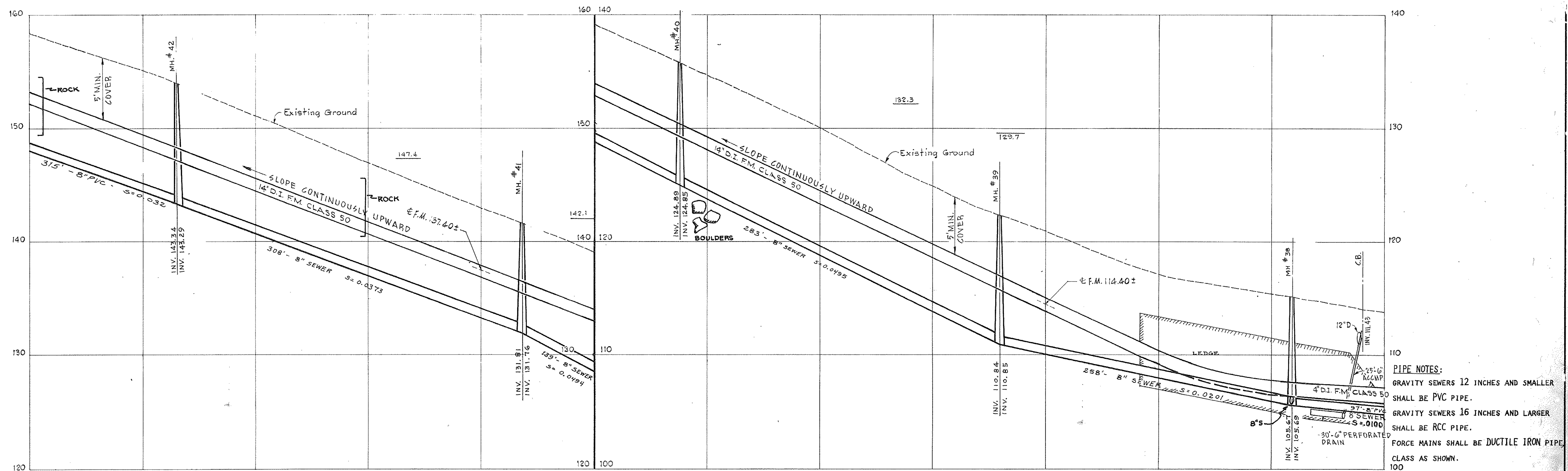
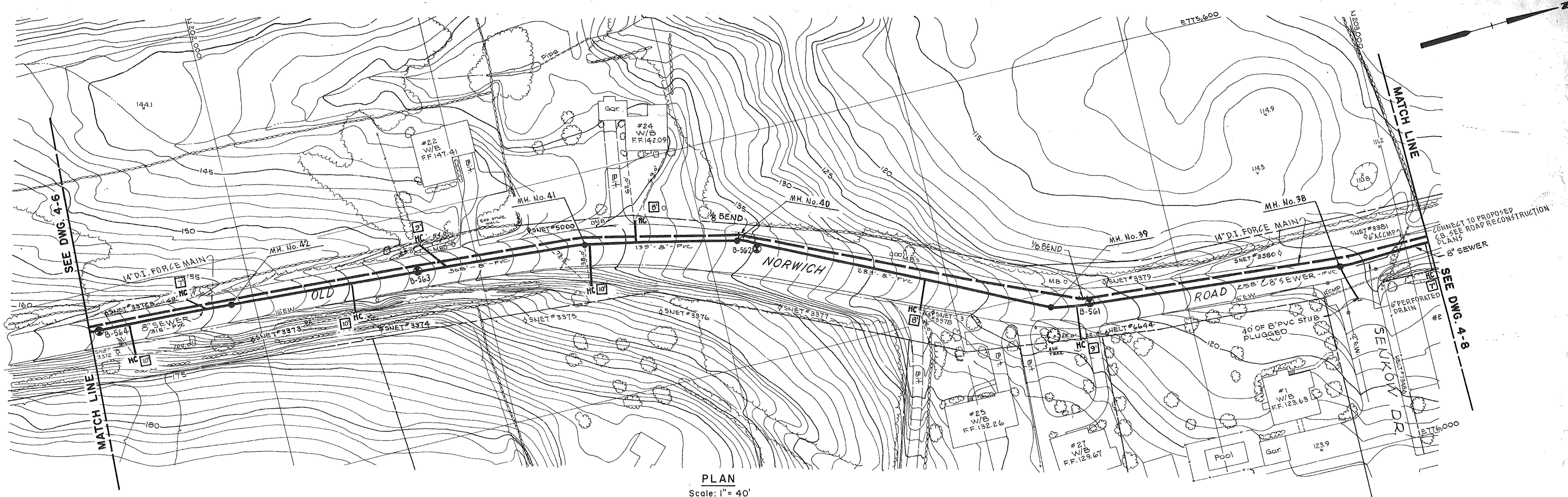
DATE: JAN 1978
 DRAWING: 4-6

LATERAL AND TRUNK SEWER PLUGS					
M.H. No.	SIZE	DIRECTION & DESCRIPTION	LENGTH	INVERT @ M.H.	INVERT @ PLUGGED END
44	8"	EASTERLY TOWARD BENHAM AVENUE	80'	160.67	160.65

PROFILE
 Hor. 1" = 40'
 Vert. 1" = 4'

RECORD, DRAWING / APPROVED - _____ CHIEF ENGINEER / DATE _____

No.	Date	Revision
1	4/81	As Built Corrections - DD



PIPE NOTES:
GRAVITY SEWERS 12 INCHES AND SMALLER SHALL BE PVC PIPE.
GRAVITY SEWERS 16 INCHES AND LARGER SHALL BE RCC PIPE.
FORCE MAINS SHALL BE DUCTILE IRON PIPE, CLASS AS SHOWN.

LATERAL AND TRUNK SEWER STUBS						
M.H. No.	STUB SIZE	DIRECTION & DESCRIPTION	LENGTH	SLOPE INV. @ R/F	INV. @ M.H.	INV. @ PLUGGED END
38	8"	EAST TOWARD SEAKOW DRIVE	40'	.005	105.88	106.08

WATER AND SEWER COMMISSION
WATERFORD CONNECTICUT
SEWAGE WORKS CONSTRUCTION PROGRAM
CONTRACT 4

QUAKER HILL INTERCEPTOR SEWER
OLD NORWICH ROAD
14" FORCE MAIN
8" SEWER



HAYDEN & HARDIN
Consulting Engineers - Boston, Massachusetts
DRAWN: H.B.
DESIGNED: J.E.E.
CHECKED: E.N.N.
APPROVED: W.H.D.
SCALE: AS NOTED
DATE: JAN. 1978
SHEET: 4-7
69189

RECORD DRAWING / APPROVED _____ CHIEF ENGINEER / DATE _____



No.	Date	Revision
3/81	AS BUILT	Corrections - DD

