

COPY NO. _____

CIDER MILL PUMP STATION UPGRADE- GL-2019-10

TOWN OF GLASTONBURY, CONNECTICUT

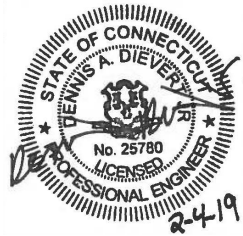
**BIDDING AND CONTRACT
REQUIREMENTS AND SPECIFICATIONS**

FEBRUARY 2019

13773A

GLASTONBURY, CONNECTICUT
BIDDING AND CONTRACT REQUIREMENTS
AND SPECIFICATIONS
FOR
CIDER MILL PUMP STATION UPGRADE- GL-2019-10

FEBRUARY 2019



Prepared By:

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Middletown, Connecticut 06457

Phone: 860-343-8297

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Town of Glastonbury

Glastonbury, Connecticut

Cider Mill Pump Station Upgrade

GL-2019-10

The Town of Glastonbury will receive sealed bids in triplicate (1 original and two copies) for the Cider Mill Pump Station Upgrade at the Office of the Purchasing Agent, Town of Glastonbury, Town Hall (second floor), 2155 Main Street, Glastonbury, Connecticut 06033, Attention: Mary F. Visone, Purchasing Agent, until 11:00 AM local time, March 7th, 2019 and then at said office publicly opened and read aloud. Bids submitted after this time will not be accepted. Each bidder must submit a sealed envelope, the outside of which must be clearly marked "BID ENCLOSED – CIDER MILL PUMP STATION UPGRADE - GL-2019-10, due date and time of opening" and the bidder's company name and address.

Bids will be received for a single prime Contract. Bids shall be on a lump sum basis as indicated in the Bid Form. Bid Forms, Plans and Specifications may be obtained on the Town's website at www.glastonbury-ct.gov.

A non-mandatory pre-bid conference will be held at the cul-de-sac of Cider Mill Road, Glastonbury, Connecticut on February 20th, 2019 at 10:00 AM. Attendance and participation is encouraged.

Sealed bids must be accompanied with Bid Security. Bid Security shall be issued payable to "Town of Glastonbury" in the form of a certified check or Bid Bond in an amount not less than 10% of the amount of the total bid. The Bid Bond must be issued by a surety company licensed in the State of Connecticut. Cashier's checks will not be accepted. Bids submitted without Bid Security will not be considered. No Bid may be withdrawn for 60 days after receipt of Bids unless released by the Owner.

The successful Bidder is required to comply with all provisions of the Civil Rights Act of 1964, the Equal Opportunity Act of 1972, Executive Orders #3, No. 17, 11246, 11375 and 11478. Contractors shall comply with State Statutes concerning Employment and Labor Practices, if applicable, and Section 31-53 of the Connecticut Statutes, as amended (Prevailing Wages).

The Town reserves the right waive informalities or reject any part of, or the entire bid, when said action is deemed to be in the best interest of the Town.

An Affirmative Action/Equal Opportunity Employer. Minority / Women / Disadvantaged Business Enterprises are encouraged to bid.

By Order of
Mary F. Visone, Purchasing Agent
Town of Glastonbury, Connecticut

+ + END OF ADVERTISEMENT FOR BIDS + +



TOWN OF GLASTONBURY * 2155 MAIN STREET * GLASTONBURY * CT

BID / PROPOSAL NO: GL-2019-10 DATE DUE: 03-07-19

DATE ADVERTISED: 02-08-19 TIME DUE: 11:00 AM

NAME OF PROJECT: Cider Mill Pump Station Upgrade

In compliance with this Invitation to Bid, the Bidder hereby proposes to provide goods and/or services as per this solicitation in strict accordance with the Bid Documents, within the time set forth therein, and at the prices submitted with their bid response.

It is the responsibility of the Bidder to clearly mark the outside of the bid envelope with the Bid Number, Date and Time of Bid Opening, and it also **THE RESPONSIBILITY OF THE BIDDER TO CHECK THE TOWN'S WEBSITE BEFORE SUBMITTING BID FOR ADDENDA POSTED PRIOR TO BID OPENING.**

THE BIDDER ACKNOWLEDGES RECEIPT OF THE FOLLOWING ADDENDA AS REQUIRED:

Addendum #1 _____(Initial/Date) Addendum #2 _____(Initial/Date) Addendum #3 _____(Initial/Date)

OTHER ITEMS REQUIRED WITH SUBMISSION OF BID PROPOSAL:

The following bid checklist describes items required for inclusion with the above-referenced bid proposal package. It is provided for the convenience of the bidders and, therefore, should not be assumed to be a complete list.

- _____ 1. Bid Bond as per Section 10 of the Information for Bidders (10% of total bid amount).
- _____ 2. Disclosure of Past and Pending Mediation, Arbitration, and Litigation cases against the Bidder or its Principals as per Section 18 of the Information for Bidders.
- _____ 3. Signed certification of bidder regarding Equal Employment Opportunity (Section 00406).
- _____ 4. Checked Town web site for Addenda and acknowledged Addenda on page BP-1.
- _____ 5. Acknowledgement of Code of Ethics on page BP-2.
- _____ 6. Included signed statement regarding Compliance with Town Ordinance Prohibiting Natural Gas Waste & Oil Waste From Natural Gas Extraction Activities or Oil Extraction Activities per Section 23 of the Information for Bidders.
- _____ 7. Clearly marked envelope with Bid Number, Date, Time of opening, Bidder's Company Name and address.
- _____ 8. List of at least five (5) similar projects completed within last three (3) years per Section 22 of the Information for Bidders.
- _____ 9. Sealed bids, one original and two copies.
- _____ 10. Copy of Bidder's Contractor's License (State of Connecticut).
- _____ 11. Signed Non-Collusion Affidavit of Prime Bidder (Section 00408).
- _____ 12. Completed Affirmative Action Statement.

Name of Bidder: _____

Item No.	Brief Description of Item with Bid Price in Words	Amount In Figures
1	Upgrade of Cider Mill Pump Station complete, including all equipment and appurtenances as specified and indicated on the drawings. The Lump Sum of \$ _____	\$ _____
	Written Amount	
2	Allowance Adder: Electrical- Telephone Service Allowance The Sum of \$ <u>Five Thousand Dollars</u>	<u>\$5,000.00</u>
	Written Amount	
3	Allowance Adder: Landscaping and Plantings Allowance The Sum of \$ <u>Five Thousand Dollars</u>	<u>\$5,000.00</u>
	Written Amount	

TOTAL BID: Total of Items 1 through 3 above. \$ _____
Total Numeric Amount

_____ **Total Written Amount**

CODE OF ETHICS:

I/We have reviewed a copy of the Town of Glastonbury's Code of Ethics and agree to submit a Consultant Acknowledgement Form if I/We are selected. Yes _____ No _____*

*Bidder is advised that effective August 1, 2003, the Town of Glastonbury cannot consider any bid or proposal where the Bidder has not agreed to the above statement.

Respectfully submitted:

_____ **Type or Print Name of Individual**

_____ **Doing Business as (Trade Name)**

_____ **Signature of Individual**

_____ **Street Address**

_____ **Title**

_____ **City, State, Zip Code**

_____ **Date**

_____ **Telephone Number/Fax Number**

_____ **E-Mail Address**

_____ **SS# or TIN#**

(Seal – If bid is by a Corporation)
 Attest

**TOWN OF GLASTONBURY
CIDER MILL PUMP STATION UPGRADE
INFORMATION FOR BIDDERS**

BID # GL-2019-10

1. Sealed bids (**one original and two copies**) on the attached Bid Forms will be received at the Office of the Purchasing Agent, Town Hall, 2155 Main Street, Glastonbury, Connecticut, 06033 (second level). At the designated time of opening, they will be publicly opened, read, recorded and placed on file.
2. Whenever it is deemed to be in the best interest of the Town, the Town Manager, Purchasing Agent or designated representative shall waive informalities in any and all bids. The right is reserved to reject any bid, or any part of any bid, when such action is deemed to be in the best interest of the Town of Glastonbury.
3. Qualified bidders shall submit a bid on a lump sum basis as provided for in the bid proposal. The basis of award will be based upon the total lump sum bid from the lowest qualified, responsible and responsive bidder.
4. Bids will be carefully evaluated as to conformance with stated specifications.
5. The bid must be submitted in a sealed envelope or package and the outside shall be clearly marked with the bid number and title, due date and time of opening, Bidder's company name and address.
6. Specifications must be submitted complete in every detail and, when requested, samples shall be provided. If a bid involves any exception from stated specifications, they must be clearly noted as exceptions, underlined, and attached to the bid.
7. The Bid Documents contain the provisions required for the requested item. Information obtained from an officer, agent, or employee of the Town or any other person shall not affect the risks or obligations assumed by the Bidder or relieve him/her from fulfilling any of the conditions of the bid.
8. Each Bidder is held responsible for the examination and/or to have acquainted themselves with any conditions at the job site which would affect their work before submitting a bid. Failure to meet these criteria shall not relieve the Bidder of the responsibility of completing the bid without extra cost to the Town of Glastonbury.
9. Any bid may be withdrawn prior to the above-scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and the date specified shall not be considered. No Bidder may withdraw a bid within sixty (60) days after the actual date of the opening thereof. Should there be reasons why a bid cannot be awarded within the specified period; the time may be extended by mutual agreement between the Town and the Bidder.
10. Each bid package must be accompanied by a bid bond payable to the Town for ten percent (10%) of the total amount of the bid. The bid bond of the successful Bidder will be retained until the payment bond and performance bond have been executed and approved, after which it will be returned. A certified check may be used in lieu of a bid bond. The Town of Glastonbury will not be liable for the accrual of any interest on any certified check submitted. Cashier's checks will not be accepted.
11. A 100% Performance Bond and a 100% Payment bond are required of the successful bidder. These bonds shall cover all aspects of the specification and shall be delivered to the Purchasing Agent prior to the issuance of a purchase order. The Performance Bond and Payment Bond will be returned upon the delivery and acceptance of the bid items.
12. The Bidder agrees and warrants that in the submission of this sealed Bid, they will not discriminate or permit discrimination against any person or group of persons on the grounds of race, color, religion,

**TOWN OF GLASTONBURY
CIDER MILL PUMP STATION UPGRADE
INFORMATION FOR BIDDERS**

BID # GL-2019-10

national origin, sex, or physical disability including, but not limited to blindness, unless it is shown by such Bidder that such disability prevents performance of that which must be done to successfully fulfill the terms of this sealed Bid or in any manner which is prohibited by the laws of the United States or the State of Connecticut: and further agrees to provide the Human Relations Commission with such information requested by the Commission concerning the employment practices and procedures of the Bidder. An Affirmative Action Statement will be required by the successful Bidder.

13. Bidder agrees to comply with all of the latest Federal and State Safety Standards and Regulations and certifies that all work required in this bid will conform to and comply with said standards and regulations. Bidder further agrees to indemnify and hold harmless the Town for all damages assessed against the Town as a result of Bidder's failure to comply with said standards and/or regulations.
14. All correspondence regarding any purchase made by the Town of Glastonbury shall reference the Town purchase order number. Each shipping container shall clearly indicate both purchase order number and item number.
15. Bidder is required to review the Town of Glastonbury Code of Ethics adopted July 8, 2003 and effective August 1, 2003 and revised October 29, 2013 and effective November 8, 2013. Bidder shall acknowledge that they have reviewed the document in the area provided on the bid/proposal response page (BP). The selected Bidder will also be required to complete and sign an Acknowledgement Form prior to award. The Code of Ethics and the Acknowledgement Form can be accessed at the Town of Glastonbury website at www.glastonbury-ct.gov. Upon entering the website click **Bids & Proposals Icon** which will bring you to the links for the **Code of Ethics** and the **Acknowledgement Form**. If the Bidder does not have access to the internet, a copy of these documents can be obtained through the Purchasing Department at the address listed within this bid/proposal.
16. Any bidder, in order to be considered, shall be engaged primarily in the business of water and sewer construction with a minimum of five (5) years experience and have a valid Contractors license in the State of Connecticut.
17. **Non-Resident Contractors:**

Upon award the Town is required to report names of nonresident (out of state) Contractors to the State of Connecticut, Department of Revenue Services (DRS) to ensure that Employment Taxes and other applicable taxes are being paid by Contractors. **A single surety bond for 5% of the entire contract price is required to be filed with DRS by any unverified nonresident prime or general contractor (if awarded) where the contract price for the project is \$250,000 or more.** The contractor will be required to promptly furnish to the Town a copy of the **Form AU-968 - Certificate of Compliance** issued by the State of Connecticut, DRS. See State of Connecticut **Notice SN 2012 (2)**.
18. Bidder shall include on a sheet(s) attached to its proposal a complete disclosure of all past and pending mediation, arbitration and litigation cases that the bidder or its principals (regardless of their place of employment) have been involved in for the most recent five years. Please include a statement of the issues in dispute and their resolution. Acceptability of Bidder based upon this disclosure shall lie solely with the Town.
19. Bidder or its principals, regardless of their place of employment, shall not have been convicted of, nor entered any plea of guilty, or nolo contendere, or otherwise have been found civilly liable or

**TOWN OF GLASTONBURY
CIDER MILL PUMP STATION UPGRADE
INFORMATION FOR BIDDERS**

BID # GL-2019-10

criminally responsible for any criminal offense or civil action. Bidder shall not be in violation of any State or local ethics standards or other offenses arising out of the submission of bids or proposals, or performance of work on public works projects or contracts.

20. After award of Contract, Owner will require the Contractor's schedule of Values, which shall be submitted at the preconstruction meeting. The Schedule of Values must accurately reflect job costs and include a complete breakdown of material and labor costs.

21. Prevailing Wage Rates:

Bidders shall comply with State Statutes concerning Employment and Labor Practices, if applicable, and Section 31-53 of the Connecticut General Statutes, as amended (Prevailing Wages). Wage Rate Determination for this project from the State of Connecticut is included in the Bid Documents. Certified payrolls for site labor shall be submitted weekly to the Town's Representative or his designee on the correct State of Connecticut form. The Town reserves the right to, without prior notice, audit payroll checks given to workers on site in order to ascertain that wages and fringe benefits are being paid as required by the State of Connecticut. Please make special note of the State requirement to adjust wage and fringe benefit rates on each July 1st following the original published rates.

NOTE that bidder is to include in its bid proposal all costs required by such annual increases in the PREVAILING RATES. No Escalation Clauses are to be included in the bidder's proposal and no Escalation Clauses will be in the Contract Agreement. Bidder is to anticipate any future increases and include these costs in its quotation.

Contractor's invoices will not be paid if certified payrolls are incomplete, incorrect or not received in a timely manner.

All Apprentices must be registered with the State of Connecticut and their number shall not exceed the number allowed by law. Otherwise, all workers must be paid at least the Journeyman rate listed including benefits.

OSHA SAFETY AND HEALTH CERTIFICATION: Effective July 1, 2009: Any Mechanic, Laborer, or Worker, who performs work in a classification listed on the prevailing wage rate schedule on any public works project covered under C.G.S. Section 31-53, both on site and on or in the public building, must have completed a federal OSHA Safety and Health course within the last 5 years.

All provisions of all applicable State Labor Standards must be complied with under this Contract. The execution of the Contract by the Bidder binds it to all applicable State Labor Laws and Regulations. All other statutory laws, to the extent they are required to be incorporated into a contract by statute, are hereby deemed fully incorporated herein and in the Contract.

22. Each Bidder shall submit a list of similar projects completed within the last three years. In order to be eligible for consideration, the Bidder must have successfully completed a minimum of five (5) similar projects within the last three (3) years. Please provide project name and contact information for project coordinator (name, title, address, phone number). Please also provide contract value.

23. Compliance with Town Ordinance Prohibiting Natural Gas Waste & Oil Waste From Natural Gas Extraction Activities or Oil Extraction Activities: If this bid is for the construction, repair or maintenance of Town owned and/or maintained roads or real property within the Town related to

**TOWN OF GLASTONBURY
CIDER MILL PUMP STATION UPGRADE
INFORMATION FOR BIDDERS**

BID # GL-2019-10

either (a) the purchase or acquisition of materials by the Town to be used to construct, repair or maintain any Town owned and/or maintained road or real property within the Town or (b) the performance of services for the Town to construct, repair or maintain any Town owned and/or maintained road or real property within the Town, the Bidder shall provide the following signed statement to the Town in its bid response, which shall be a certification under penalty of perjury by the Bidder:

“The undersigned Bidder, _____, hereby submits a bid for materials, equipment and/or services for the Town of Glastonbury. The bid is for bid documents titled Cider Mill Pump Station Upgrade.

The undersigned Bidder hereby certifies under penalty of perjury that in connection with the bid and, if it is awarded the purchase order or contract by the Town, in connection with any purchase order or contract: (1) no materials containing natural gas waste or oil waste from natural gas extraction activities or oil extraction activities shall be provided to the Town or shall be used in providing any services to the Town by the undersigned Bidder or any contractor, sub-contractor or agent of the undersigned Bidder; (b) nor will the undersigned Bidder or any contractor, subcontractor or agent of the undersigned Bidder apply any natural gas waste or oil waste from natural gas extraction activities or oil extraction activities to any publicly owned and/or maintained road or real property within the Town of Glastonbury in performing its obligations under the purchase order or contract. The undersigned Bidder hereby agrees and acknowledges that this requirement shall be a term of the purchase order or contract, if it awarded the purchase order or contract by the Town, and any breach of this provision shall be a breach of the purchase order or contract.”

24. Technical questions regarding this bid shall be made in writing and directed to Mike Bisi, Sanitation Superintendent email: mike.bisi@glastonbury-ct.gov copying the Engineer of Record, Dennis Dievert Jr email: dennis.dievert@wright-pierce.com. For administrative questions regarding this Bid, please contact Mary F. Visone, Purchasing Agent, email: purchasing@glastonbury-ct.gov copying the Engineer of Record, Dennis Dievert Jr email: dennis.dievert@wright-pierce.com. All questions, answers, and/or addenda, as applicable will be posted on the Town’s website at www.glastonbury-ct.gov. (Upon entering the website click on Bids & Proposals Icon, click the Bid Title to view all bid details and document links.). The request must be received at least ten (10) calendar days prior to the advertised response deadline. **It is the respondent’s responsibility to check the website for addenda prior to submission of any bid/proposal.**
25. Municipal construction projects are exempt from Federal Excise Taxes, as well as, State of Connecticut Sales, Use and Service Taxes and should not be include in the Bidder’s proposal.

IMPORTANT: Failure to comply with general rules may result in disqualification of the Bidder.

SECTION 00406

CERTIFICATION OF BIDDER REGARDING
EQUAL EMPLOYMENT OPPORTUNITY

INSTRUCTIONS

This certification is related to Connecticut's Executive Order No. Three. This statement relates to a proposed contract with the Town of Glastonbury, Connecticut. The bidder shall state as an initial part of the bid whether it has participated in any pervious contract or subcontract subject to the equal opportunity clause; and if so, whether it has filed all compliance reports due under applicable instructions.

Where the certification indicates that the bidder has not filed a compliance report due under applicable instructions, such bidder, if the Successful Bidder, shall not eligible and will not be eligible to enter into the proposed contract unless and until such reports are filed in a manner that is satisfactory to the Commission on Human Rights and Opportunities. Such reports shall be filed within seven days of notice of award.

CERTIFICATION BY BIDDER

Bidder's Name: _____

Address and Zip Code: _____

1. Bidder has participated in a previous contract or subcontract subject to Executive Order No. Three (regarding equal employment opportunity) or a preceding similar Executive Order.
Yes ____ No ____ (If answer is yes, identify the most recent contract.)

2. If Yes, all required compliance reports were filed in connection with such contract or subcontract.
Yes ____ No ____

3. Bidder has a written Affirmative Action Plan.
Yes ____ No ____

4. This plan has been approved by the Connecticut Commission on Human Rights and Opportunities.
Yes ____ No ____

5. Bidder has an apprenticeship program complying with Sections 46a-68-1 to 46a-68-17, inclusive, of the Regulations of Connecticut State Agencies.

Yes _____ No _____

The information above is true and complete to the best of my knowledge and belief.

Name and Title of Signer (Please Type)

Signature

Date

END OF SECTION

SECTION 00408

NON-COLLUSION AFFIDAVIT OF PRIME BIDDER

State of: _____

County of: _____

_____, being first duly sworn, deposes and says that:

1. Bidder is _____ of _____, the Bidder that has submitted the attached Bid;
2. Bidder is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;
3. Such Bid is genuine and is not a collusive or sham Bid;
4. Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees of parties of interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly with any other Bidder, firm or person to submit a collusive or sham Bid in Connection with the Contract for which the attached Bid has been submitted or to refrain from bidding in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, firm or person to fix the price or prices in the attached Bid or of any other Bidder, or to fix any overhead, profit or cost element of the Bid price or the Bid price of any Bidder, or to secure through any collusion, conspiracy, connivance or unlawful agreement of any advantage against the Town of Trumbull, Connecticut or any person interested in the proposed Contract; and
5. The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

(Signed)

(Title)

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

(Title)

My Commission Expires on _____

END OF SECTION

SECTION 00510SUGGESTED FORM OF AGREEMENT
BETWEEN OWNER AND CONTRACTORFOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

THIS AGREEMENT is by and between Town of Glastonbury ("Owner") and
 _____ ("Contractor").

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified, indicated in, and reasonably inferable from the Contract Documents. The Work is generally described as follows:

All labor, materials, equipment and services required for the conversion of the existing pump station to a submersible style station, including but not limited to, the demolition of the existing can station and generator, the construction of a new precast wetwell and building, the installation of new submersible sewage pumps, stand-by generator, piping, valves, heating, ventilation and electrical distribution and control systems.

ARTICLE 2 – THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows:

Town of Glastonbury, Connecticut
 Cider Mill Pump Station Upgrade - GL-2019-10

ARTICLE 3 – ENGINEER

3.01 The Project has been designed by Wright-Pierce (Engineer).

3.02 The Owner has retained Wright-Pierce ("Engineer") 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 subject to any limitations set forth in the agreement between the Engineer and the Owner in connection with the Project.

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 Contract Times: Days

- A. The Work will be substantially completed within 210 days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 240 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 the Contractor's failure to complete the Work within the Contract Times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract, will cause the Owner to incur substantial economic damages and losses of types and in amounts which are impossible to compute and ascertain with certainty as a basis for recovery by the Owner of actual damages, and that liquidated damages represent a fair, reasonable and appropriate estimate thereof. Accordingly, in lieu of actual damages for such delay, the Contractor agrees that liquidated damages may be assessed and recovered by the Owner as against Contractor and its Surety in the event of delayed completion, without the Owner being required to present any evidence of the amount or character of actual damages sustained by reason thereof. Therefore, Contractor shall be liable to the Owner for payment of liquidated damages as set forth below. Such liquidated damages are intended to represent estimated actual damages and are not intended as a penalty, and Contractor shall pay them to Owner without limiting Owner's right to terminate this Contract as provided elsewhere herein.
1. Substantial Completion: Contractor shall pay Owner \$500 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.
 2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$250 for each day that expires after such time until the Work is completed and ready for final payment.
 3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.
 4. The Owner shall have the right to offset amounts owed by the Contractor for liquidated damages against amounts due or coming due to the Contractor for Work performed under this Contract.

ARTICLE 5 – CONTRACT PRICE

Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents and the amounts set forth in the Bid Proposal Form.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 Submittal and Processing of Payments

- A. Contractor shall submit Applications for Payment in accordance with Article 15 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 within forty-five days after submission of an Application for Payment to the Engineer and the Owner as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been recommended for payment by Engineer, have been submitted in a timely manner, and otherwise meet the requirements of the Contract Documents. All such payments will be based on the percentage of completion of the Work in each case as measured by the Schedule of Values established as provided in 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 elsewhere in the Contract.
 - 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 the Contract
 - a. 95 percent of Work completed (with the balance being retainage); and
 - b. 95 percent of cost of materials and equipment delivered and properly stored on the site but not yet incorporated in the Work (with the balance being retainage).
- B. The Owner shall have no obligation to release retainage until final completion of the Work. Notwithstanding, upon Substantial Completion of the entire construction to be provided under the Contract Documents, Owner may, in its discretion pay an amount sufficient to increase total payments to Contractor to 98% percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less 200% percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.
- C. The Contractor, within ten (10) days after payment to the Contractor by the Owner shall pay any amounts due any Subcontractor, whether for labor performed or materials furnished, when the labor or materials have been included in a requisition submitted by the Contractor and paid by the Owner. The Contractor shall promptly give notice to the Owner of any claim or demand by a Subcontractor claiming that any amount is due to such Subcontractor or claiming any default by the Contractor in any of the Contractor's obligations to such Subcontractor.

The Contractor shall include in each of its Subcontracts a provision requiring each Subcontractor to pay any amounts due any of its subcontractors, whether for labor performed or materials furnished, within ten (10) days after such Subcontractor receives a payment from the Contractor which encompasses labor or materials furnished by the sub-subcontractor and a provision requiring each Subcontractor to promptly give notice to the Contractor of any claim or demand

by a Sub-subcontractor claiming that any amount is due to such Sub-subcontractor or claiming any default by such Subcontractor in any of its obligations to such Sub-subcontractor which notice the Contractor shall promptly relay to the Owner.

6.03 Final Payment

A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06.

6.04 Miscellaneous

A. No interest will be paid to the Contractor on retainage funds.

B. Nothing in this Article 6 shall limit the ability of the Engineer to recommend against payment or the right to the Owner to withhold payment, each as provided in Article 14 of the General Conditions.

ARTICLE 7 – INTEREST

7.01 Not Used

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

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

A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.

B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, 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 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 adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

E. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no 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.

F. 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.

- G. 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.
- H. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- I. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 Contents

- A. The Contract Documents consist of the following:
 - 1. This Agreement (pages 1 to █, inclusive).
 - 2. Performance bond (pages █ to █, inclusive).
 - 3. Payment bond (pages █ to █, inclusive).
 - 4. Other bonds.
 - a. █ (pages █ to █, inclusive).
 - 5. General Conditions (pages █ to █, inclusive).
 - 6. Supplementary Conditions (pages █ to █, inclusive).
 - 7. Specifications as listed in the table of contents of the Project Manual.
 - 8. Drawings (not attached but incorporated by reference) consisting of █ sheets with each sheet bearing the following general title: █ [or] the Drawings listed on the attached sheet index.
 - 9. Addenda (numbers █ to █, inclusive).
 - 10. Exhibits to this Agreement (enumerated as follows):
 - Contractor's Bid (pages █ to █, inclusive).
 - 11. The following which may be delivered or issued on or after the Effective Date of the Contract 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 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. Unless expressly agreed to elsewhere in the Contract, 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, money that may become due and money that is 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 successors, assigns, and legal representatives to the other party hereto, its 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.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

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

OWNER:

CONTRACTOR:

By: _____

By: _____

Title: _____

Title: _____

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

Attest: _____

Attest: _____

Title: _____

Title: _____

Address for giving notices:

Address for giving notices:

License No.: _____
(where applicable)

Approved as to Form:

Approved as to Funding:

Bruce A. Chudwick, Partner
Shipman & Goodwin LLP
As Town Attorney,
Town of Glastonbury

Julie Twilley
Director of Finance and
Administrative Services
Town of Glastonbury

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



Issued and Published Jointly by



These General Conditions have been prepared for use with the Agreement Between Owner and Contractor for Construction Contract (EJCDC® C-520, Stipulated Sum, or C-525, Cost-Plus, 2013 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other.

To prepare supplementary conditions that are coordinated with the General Conditions, use EJCDC's Guide to the Preparation of Supplementary Conditions (EJCDC® C-800, 2013 Edition). The full EJCDC Construction series of documents is discussed in the Commentary on the 2013 EJCDC Construction Documents (EJCDC® C-001, 2013 Edition).

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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, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. 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, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 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. Bid—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. Bidder—An individual or entity that submits a Bid to Owner.
 6. Bidding Documents—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. Bidding Requirements—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. Change Order—A document 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, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. Change Proposal—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. Claim—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer

has declined to address. A demand for money or services by a third party is not a Claim.

11. Constituent of Concern—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. (“CERCLA”); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. (“RCRA”); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. Contract—The entire and integrated written contract between the Owner and Contractor concerning the Work.
13. Contract Documents—Those items so designated in the Agreement, and which together comprise the Contract.
14. Contract Price—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .
15. Contract Times—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. Contractor—The individual or entity with which Owner has contracted for performance of the Work.
17. Cost of the Work—See Paragraph 13.01 for definition.
18. Drawings—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. Effective Date of the Contract—The date, indicated in the Agreement, on which the Contract becomes effective.
20. Engineer—The individual or entity named as such in the Agreement.
21. Field Order—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
22. Hazardous Environmental Condition—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.
23. Laws and Regulations; Laws or Regulations—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

24. Liens—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
25. Milestone—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.
26. Notice of Award—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
27. Notice to Proceed—A written notice 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.
28. Owner—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
29. 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.
30. Project—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
31. Project Manual—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. Resident Project Representative—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.
33. Samples—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
34. Schedule of Submittals—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.
35. 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.
36. Shop Drawings—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. 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, and such other lands furnished by Owner which are designated for the use of Contractor.
38. Specifications—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
39. 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.
40. 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.
41. Successful Bidder—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
42. Supplementary Conditions—The part of the Contract that amends or supplements these General Conditions.
43. 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 a Subcontractor.
44. Technical Data—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.
45. 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 but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
46. Unit Price Work—Work to be paid for on the basis of unit prices.
47. 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; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

48. Work Change Directive—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in the following paragraphs 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 Article 10 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 15.03 or 15.04).
- 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. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.
- 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. Bonds: 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 Contractor's Insurance: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.
- C. Evidence of Owner's Insurance: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 Copies of Documents

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 Before Starting Construction

- A. Preliminary Schedules: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), 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;
 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.

2.04 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 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, 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 and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 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 2.03.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 the component parts of the Work.

2.06 Electronic Transmittals

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.
- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or

computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, 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.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 Reference Standards

- A. Standards Specifications, Codes, Laws and Regulations
 - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, 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, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract 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, reference standard, 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 part of the Contract Documents prepared by or for Engineer. 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 part of the Contract Documents prepared by or for Engineer.

3.03 Reporting and Resolving Discrepancies

- A. Reporting Discrepancies:
 - 1. Contractor's Verification of Figures and Field Measurements: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict,

error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

2. Contractor's Review of Contract Documents: If, before or 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) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) 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 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
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 part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); 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 Requirements of the Contract Documents

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 Reuse of Documents

- A. Contractor and its Subcontractors and Suppliers 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 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; or
 - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- 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.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 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 Contract 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 Contract. 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 Contract, whichever date is earlier.

4.02 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 such date.

4.03 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.

4.04 Progress Schedule

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 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 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.
- B. 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, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.
- 4.05 Delays in Contractor's Progress
- A. If Owner, Engineer, 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 Times and Contract Price. 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.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. 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. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 2. abnormal weather conditions;
 3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
 4. acts of war or terrorism.
- D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.
- E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.
- F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

- G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 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.
- 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 permanent improvements are to be made 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.

5.02 Use of Site and Other Areas

- A. Limitation on Use of Site and Other Areas:
 - 1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
 - 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, 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 any such claim, and against all 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 directly or indirectly, in whole or in part

by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

- B. Removal of Debris During Performance of the Work: During the progress of the Work the Contractor shall keep the Site and other adjacent 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 and adjacent areas 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 of 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 structures or land to stresses or pressures that will endanger them.

5.03 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 adjacent to the Site;
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
 - 3. Technical Data contained in such reports and drawings.
- B. Reliance by Contractor on Technical Data Authorized: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on 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.

5.04 Differing Subsurface or Physical Conditions

- A. Notice by Contractor: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site 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 5.03 is materially inaccurate; or
 2. is of such a nature as to require a change in the Drawings or Specifications; 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 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. Engineer's Review: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. Owner's Statement to Contractor Regarding Site Condition: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. Possible Price and Times Adjustments:
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, 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 fall within any one or more of the categories described in Paragraph 5.04.A;
 - 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 Paragraph 13.03; and,

- c. 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.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a 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 otherwise; or
 - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 5.04.A.
 3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
 4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 Underground Facilities

- A. Contractor's Responsibilities: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent 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 do not warrant or guarantee 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 information and data regarding existing Underground Facilities at the Site;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 - d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. Notice by Contractor: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then 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 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

- C. Engineer's Review: Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. Owner's Statement to Contractor Regarding Underground Facility: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. Possible Price and Times Adjustments:
 - 1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
 - 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 Paragraph 13.03;
 - c. 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; and
 - d. Contractor gave the notice required in Paragraph 5.05.B.
 - 2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
 - 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 Hazardous Environmental Conditions at Site

- A. Reports and Drawings: The Supplementary Conditions identify:
1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
 2. Technical Data contained in such reports and drawings.
- B. Reliance by Contractor on Technical Data Authorized: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on 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 removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) 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 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. 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, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.
- H. 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, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.
- I. 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 (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.H shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. 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 failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 Performance, Payment, and Other Bonds

- A. Contractor shall furnish a performance bond and a payment bond, 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. 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 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.
- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond 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 the accompanying bond.
- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then 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 bond and surety requirements above.
- E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.
- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 Insurance—General Provisions

- A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is

maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

- D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, 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.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.
- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 Contractor's Insurance

- A. Workers' Compensation: Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
 - 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
 - 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

4. Foreign voluntary worker compensation (if applicable).
- B. Commercial General Liability—Claims Covered: Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:
1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
 2. claims for damages insured by reasonably available personal injury liability coverage.
 3. 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.
- C. Commercial General Liability—Form and Content: Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage:
 - a. Such insurance shall be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Broad form property damage coverage.
 4. Severability of interest.
 5. Underground, explosion, and collapse coverage.
 6. Personal injury coverage.
 7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
 8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- D. Automobile liability: Contractor shall purchase and maintain automobile liability insurance against 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. The automobile liability policy shall be written on an occurrence basis.
- E. Umbrella or excess liability: Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
- F. Contractor's pollution liability insurance: Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result

of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

- G. Additional insureds: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; 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 (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
- H. Contractor's professional liability insurance: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- I. General provisions: The policies of insurance required by this Paragraph 6.03 shall:
 - 1. include at least the specific coverages provided in this Article.
 - 2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.
 - 3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
 - 4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
 - 5. be appropriate for the Work being performed and provide protection from claims that 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.
- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 Owner's Liability Insurance

- A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, 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.
- B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 Property Insurance

- A. Builder's Risk: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable 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 Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
 - 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; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; 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. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.
 - 3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 - 4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).

5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
 6. extend to cover damage or loss to insured property while in transit.
 7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
 8. allow for the waiver of the insurer's subrogation rights, as set forth below.
 9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
 10. not include a co-insurance clause.
 11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
 12. include performance/hot testing and start-up.
 13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.
- B. Notice of Cancellation or Change: All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.
- C. Deductibles: The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- D. Partial Occupancy or Use by Owner: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
- E. Additional Insurance: If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.
- F. Insurance of Other Property: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 Waiver of Rights

- A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, 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 insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the 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 Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, 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 or Contractor as trustee or fiduciary, 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 occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.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, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.
- D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, 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 builder's risk insurance and any other property insurance applicable to the Work.

6.07 Receipt and Application of Property Insurance Proceeds

- A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the

policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 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.
- 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.

7.02 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, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 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, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work 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.

7.04 "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 Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item 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 is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that 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, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, 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;
 - 3) it has a proven record of performance and availability of responsive service; and
 - 4) it is not objectionable to Owner.
 - 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.
- B. Contractor's Expense: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. Engineer's Evaluation and Determination: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

- D. Effect of Engineer's Determination: Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.
- E. Treatment as a Substitution Request: If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 Substitutes

- A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.
 - 1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.
 - 2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
 - 3. 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:
 - a. shall certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design,
 - 2) be similar in substance to that specified, and
 - 3) be suited to the same use as that specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
 - 2) 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
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from that specified, and

- 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. **Engineer's Evaluation and Determination:** Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
 - C. **Special Guarantee:** Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
 - D. **Reimbursement of Engineer's Cost:** Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. 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.
 - E. **Contractor's Expense:** Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
 - F. **Effect of Engineer's Determination:** If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 Concerning Subcontractors, Suppliers, and Others

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.
- F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. 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 the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. 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.
- J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
- K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.
- L. 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.
- M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
- N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

O. 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 money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 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.

7.08 Permits

- A. Unless otherwise provided in the Contract Documents, 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 the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

7.09 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.

7.10 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 or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and 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 such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 Record Documents

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

7.12 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, other work in progress, 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 Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
 - 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 7.12.A.2 or 7.12.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 at its expense (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 protection 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 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).
 - G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 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.

7.14 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.

7.15 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.

7.16 Shop Drawings, Samples, and Other Submittals

- A. Shop Drawing and Sample Submittal Requirements:
 1. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated the 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 and equipment 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 of that submittal, and that Contractor approves the 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 set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.
- B. Submittal Procedures for Shop Drawings and Samples: Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.
 1. Shop Drawings:
 - a. Contractor shall submit the number of copies required in the Specifications.
 - 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 7.16.D.

2. Samples:
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall 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 7.16.D.
 3. 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. Other Submittals: Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.
- 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 or to safety precautions or programs incident thereto.
 3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
 4. Engineer's review and approval of a Shop Drawing or Sample 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 7.16.A.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 will document any such approved variation from the requirements of the Contract Documents in a Field Order.
 5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
 6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
 7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.
- 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.
 2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
 3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 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 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;
 6. the issuance of a notice of acceptability by Engineer;
 7. any inspection, test, or approval by others; or
 8. any correction of defective Work by Owner.

- D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 Indemnification

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, 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 7.18.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 7.18.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.

7.19 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 Laws and Regulations.
- 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, 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, 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 7.16.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 Other Work

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. 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.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, 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.

8.02 Coordination

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
 - 1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 - 2. an itemization of the specific matters to be covered by such authority and responsibility; and
 - 3. the extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 Legal Relationships

- A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. 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.
- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.
- C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

- D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) 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 any such claims, and against all 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 damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 Communications to Contractor

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

9.02 Replacement of Engineer

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.03 Furnish Data

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

9.04 Pay When Due

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 Lands and Easements; Reports, Tests, and Drawings

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 Insurance

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 Change Orders

- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 Inspections, Tests, and Approvals

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 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.

9.10 Undisclosed Hazardous Environmental Condition

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 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 (including obligations under proposed changes in the Work).

9.12 Safety Programs

- 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.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 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.

10.02 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 10.08. 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.

10.03 Project Representative

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. 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.

10.04 Rejecting Defective Work

- A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 Shop Drawings, Change Orders and Payments

- A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.
- B. 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, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 Determinations for Unit Price Work

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.07 Decisions on Requirements of Contract Documents and Acceptability of Work

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 Limitations on Engineer's Authority and Responsibilities

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, 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 15.06.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 10.08 shall also apply to the Resident Project Representative, if any.

10.09 Compliance with Safety Program

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 Amending and Supplementing Contract Documents

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
 - 1. Change Orders:
 - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
 - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.
 - 2. Work Change Directives: A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an

adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. Field Orders: Engineer may authorize minor changes in the Work if the changes 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. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 Owner-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. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 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, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 Change of Contract Price

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.
- B. 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, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on

the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

- C. Contractor's Fee: When applicable, 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 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 13.01.B.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 11.01.C.2.a and 11.01.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - 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 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 Change of Contract Times

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 Change Proposals

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under

the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. **Procedures:** Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.
 2. **Engineer's Action:** Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.
 3. **Binding Decision:** Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- B. **Resolution of Certain Change Proposals:** If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 Execution of Change Orders

- A. Owner and Contractor shall execute appropriate Change Orders covering:
1. 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;
 2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
 4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 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.

ARTICLE 12 – CLAIMS

12.01 Claims

- A. Claims Process: The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
 - 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 - 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 - 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.
- B. Submittal of Claim: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. Review and Resolution: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. Mediation:
 - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim

submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. Partial Approval: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. Denial of Claim: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. Final and Binding Results: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 Cost of the Work

- A. Purposes for Determination of Cost of the Work: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. Costs Included: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work 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 13.01.C, 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, and 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 13.01.
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 6.05), 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 communication 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 that Contractor is required by the Contract Documents to purchase and maintain.
- C. 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 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here 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 Paragraph 13.01.B.
- D. Contractor's Fee: When the Work as a whole 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, Change Proposal, Claim, set-off, or other 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 11.04.C.
- E. Documentation: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, 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.

13.02 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: Contractor agrees that:
 - 1. 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
 - 2. 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: 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.

13.03 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. Payments to Contractor for Unit Price Work will be based on actual quantities.
- 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. 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 the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price 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;
 - 2. there is no corresponding adjustment with respect to any other item of Work; and
 - 3. Contractor believes that it 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 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 Access to Work

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction 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.

14.02 Tests, Inspections, and Approvals

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.
- 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, obtaining, and paying for all inspections and tests required:
 - 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 - 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 - 3. by manufacturers of equipment furnished under the Contract Documents;
 - 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 - 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. 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. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to

cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 Defective Work

- A. Contractor's Obligation: It is Contractor's obligation to assure that the Work is not defective.
- B. Engineer's Authority: Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. Notice of Defects: Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. Correction, or Removal and Replacement: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. Preservation of Warranties: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. Costs and Damages: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 Acceptance of Defective Work

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages 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. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 Uncovering Work

- A. Engineer has the authority to require special inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then 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, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages 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 pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. 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, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 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, then 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.

14.07 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, 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, then 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 14.07, 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, 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 incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. 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 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 Progress Payments

- A. Basis for Progress Payments: The Schedule of Values established as provided in Article 2 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 during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. 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, a warehouse bond, 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.
- C. Review of Applications:
1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, 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 13.03, 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; 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 money 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 15.01.C.2.
 6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

- e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.
- D. Payment Becomes Due:
- 1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.
- E. Reductions in Payment by Owner:
- 1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. the Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. the Contract Price has been reduced by Change Orders;
 - i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
 - j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. 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;
 - l. there are other items entitling Owner to a set off against the amount recommended.
 - 2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, 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, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

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 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 Contractor's Warranty of Title

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 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 and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- 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 preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. 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 punch list.

15.04 Partial Use or Occupancy

- 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. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be 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 15.03.A through E for that part of the Work.
 - 2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work 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 15.03 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 6.05 regarding builder's risk or other property insurance.

15.05 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, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 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, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all disputes that Contractor believes are unsettled; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) 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, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

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 have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. 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 15.07. 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. Completion of Work: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.

D. Payment Becomes Due: Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation,

including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 Waiver of Claims

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 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 Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such other adjacent areas;
 - 2. correct such defective Work;
 - 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 to 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. 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 repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).
- 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, 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 are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 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 written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 Owner May Terminate for Cause

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and 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);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, 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 complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.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 the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses,

and damages exceeds 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.

- F. 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, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 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; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 Contractor May Stop Work or Terminate

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) 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 16.03.
- 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 are not intended to preclude Contractor from submitting a Change Proposal 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 17 – FINAL RESOLUTION OF DISPUTES

17.01 Methods and Procedures

- A. Disputes Subject to Final Resolution: The following disputed matters are subject to final resolution under the provisions of this Article:
 - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
 - 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.
- B. Final Resolution of Disputes: For any dispute subject to resolution under this Article, Owner or Contractor may:
 - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
 - 2. agree with the other party to submit the dispute to another dispute resolution process; or
 - 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 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, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
 - 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 Computation of Times

- A. When any period of time is referred to in the Contract 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.

18.03 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. 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.

18.04 Limitation of Damages

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 No Waiver

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 Survival of Obligations

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

18.07 Controlling Law

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

18.08 Headings

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

SECTION 00800SUPPLEMENTARY CONDITIONSSupplementary Conditions

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract Funding Agency Edition, EJCDC C-700 (2013 Edition). 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

SC-1.01.A.3. APPLICATION FOR PAYMENT

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

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

SC-1.01.A.8. CHANGE ORDER

Add the following language to the end of Paragraph 1.01.A.8 of the General Conditions:

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

SC-1.01 A.40

Add the following to the end of Paragraph 1.01.A.40 of the General Conditions:

Substantial Completion shall not be deemed by the Engineer to have been achieved until such time as a Certificate of Occupancy (or other similar form of government approval) has been issued for the Project indicating completion of the Work in accordance with applicable law.

SC-1.01 A.49 ABNORMAL WEATHER CONDITIONS

Add the following new paragraph after Paragraph 1.01.A.48 of the General Conditions:

49. *Abnormal Weather Conditions* – Conditions of extreme or unusual weather for a given region, elevation, or season as determined by Engineer. Extreme or unusual weather that is that is typical for a given region, elevation, or season should not be considered Abnormal Weather Conditions.

SC-1.01 A.50 NON-RESIDENT CONTRACTOR

Add the following new paragraph after Paragraph 1.01.A.49 of the General Conditions:

50. *Non-resident Contractor* - “Nonresident contractor” means a contractor or subcontractor who does not maintain a regular place of business in this state.

SC-1.01.A.51 GEOTECHNICAL DATA REPORT

Add the following new paragraph after Paragraph 1.01.A.50 of the General Conditions:

51. *Geotechnical Data Report (GDR)* — Report dated August 31, 2017, prepared by Welti Geotechnical, PC, Glastonbury, CT, entitled: “Geotechnical Study for Proposed New Cider Mill Pump Station, Cider Mill Road, Glastonbury, CT”, consisting of 6 pages. The factual report that collects and presents data regarding actual subsurface conditions at or adjacent to the Site, including Technical Data and other geotechnical data, prepared by or for Owner in support of the Geotechnical Baseline Report. The GDR’s content may include logs of borings, trenches, and other site investigations, recorded measurements of subsurface water levels, the results of field and laboratory testing, and descriptions of the investigative and

testing programs. The GDR does not include an interpretation of the data. If opinions, or interpretive or speculative non-factual comments or statements appear in a document that is labeled a GDR, such opinions, comments, or statements are not operative parts of the GDR and do not have contractual standing. Subject to that exception, the GDR is a Contract Document.

SC-2.01 DELIVERY OF BONDS AND EVIDENCE OF INSURANCE

Delete Section 2.01.C of the General Conditions in its entirety .

SC-2.02 COPIES OF DOCUMENTS

Delete Paragraph 2.02.A of the General Conditions 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.

Delete Paragraph 2.02.B of the General Conditions in its entirety and insert the following in its place:

- B. Engineer shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Engineer shall make such original printed record version of the Contract available to Contractor for review.

SC-2.05 INITIAL ACCEPTANCE OF SCHEDULES

Delete Paragraph 2.05 of the General Conditions in its entirety and insert the following in its place:

2.05 Initial Acceptance of Schedules

At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, Owner and others as appropriate, will be held to review for acceptability to Engineer and Owner as provided below the schedules submitted in accordance with Paragraph 2.03.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 the Progress Schedule, Contractor's Schedule of Submittals and Contractor's Schedule of Values have been accepted by the Engineer and the Owner. The Engineer's and Owner's acceptance of the foregoing schedules shall not impose any responsibility on the Owner or the Engineer for sequencing, scheduling or progress of the Work nor interfere with or relieve Contractor from Contractor's full responsibility therefore.

SC-2.07 NON-RESIDENT CONTRACTOR

Add a new Paragraph 2.07 immediately after Paragraph 2.06 of the General Conditions, which is to read as follows:

2.07 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 3.01 INTENT

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

- F. 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-3.03 REPORTING AND RESOLVING DISCREPANCIES

Delete Paragraph 3.03.A.3 of the General Conditions in its entirety and insert the following in its place:

- 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 or, would have had knowledge thereof if Contractor had exercised the Contractor's Standard of Care.

SC-4.01 COMMENCEMENT OF CONTRACT TIMES; NOTICE TO PROCEED

Delete Paragraph 4.01.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 which may be given at any time within 90 days after the Effective Date of the Agreement.

SC 4.03 REFERENCE POINTS

Add a new paragraph immediately after Paragraph 4.03A of the General Conditions which is to read as follows:

- B. Engineer may check the lines, elevations, reference marks, batter boards, etc., set by Contractor, and Contractor shall correct any errors identified by the Engineer. Such a check shall not be considered as approval of Contractor's Work and shall not relieve Contractor of the responsibility for accurate construction of the entirety of the Work. Contractor shall furnish personnel to assist Engineer in checking lines and grades.

SC 4.05 DELAYS IN CONTRACTOR'S PROGRESS

Amend Paragraph **4.05.A** of the General Conditions by adding the following sentence to the end of the Paragraph:

No adjustment in the Contract Price shall exceed the Contractor's actual direct costs caused by the delay, disruption or interference in the Work and no adjustment in the Contract Times shall exceed the period of actual delay in Work activities that are on the critical path of the Project Schedule.

Amend Paragraph **4.05.C.2** of the General Conditions by striking out the following text: "abnormal weather conditions;" and inserting the following text: "Abnormal Weather Conditions".

Amend Paragraph **4.05.G** of the General Conditions by adding the following sentence to the end of the Paragraph:

Contractor's failure to timely submit a Change Proposal shall be deemed a waiver of the Contractor's right to submit a Claim in connection with the delaying, disrupting or interfering event.

SC-5.01 Availability of Lands

Delete Section 5.01.B of the General Conditions in its entirety.

SC-5.02.A Limitation on Use of Site and Other Areas

Delete Paragraph 5.02A.2 in its entirety and insert the following in its place:

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor, Subcontractors or those for which or whom any of them is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify, defend 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 any such claim, and against all 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 directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor, Subcontractors or those for which or whom any of them is responsible. This indemnification obligation shall not include liability for damage arising out of bodily injury to persons or damage to property to the extent caused by or resulting from the negligence of the indemnitee, such indemnitee's agents or employees.

SC-5.03 Subsurface and Physical Conditions

Add the following new paragraph immediately after Paragraph 5.03.B of the General Conditions:

- C. The following reports of explorations and tests of subsurface conditions at or adjacent to the Site are known to Owner:
 - 1. Report dated August 31, 2017, prepared by Welti Geotechnical, PC, Glastonbury, CT, entitled: "Geotechnical Study for Proposed New Cider Mill Pump Station, Cider Mill Road, Glastonbury, CT", consisting of 6 pages. The Technical Data contained in such report upon whose accuracy Contractor may rely are those indicated in the definition of Technical Data in Paragraph 1.01A.44 of the General Conditions.

SC-5.04 Differing Subsurface or Physical Conditions

Delete subparagraph 5.04.D.1 of the General Conditions and insert the following in its place:

- 1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, 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 fall within any one or more of the categories described in Paragraph 5.04.A;
 - 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 Paragraph 13.03;
 - c. 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; and
 - d. The adjustment in the Contract Price shall not exceed Contractor's actual increase in direct costs caused by the existence of the differing subsurface or physical condition and no adjustment in the Contract Times shall exceed the period of actual delay in Work activities that are on the critical path of the Project Schedule that is caused by the existing of the differing subsurface or physical condition.

SC-5.05 Underground Facilities

Delete subparagraph 5.05.E.1 of the General Conditions and insert the following in its place:

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
 - 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 Paragraph 13.03;
 - c. 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;
 - d. The adjustment in the Contract Price shall not exceed Contractor's actual increase in direct costs caused by the existence of the Underground Utility and no adjustment in the Contract Times shall exceed the period of actual delay in Work activities that are on the critical path of the Project Schedule caused by the existence of the Underground Utility; and
 - e. Contractor gave the notice required in Paragraph 5.05.B.

SC-5.06 HAZARDOUS ENVIRONMENTAL CONDITIONS

Add the following **Paragraph 5.06.A.3** after Paragraph 5.06.A.2 of the General Conditions:

3. The following reports regarding Hazardous Environmental Conditions at the Site are known to Owner and included as an appendix to the Specifications:
 - a. Report dated August 14, 2017, prepared by Tattvam Environmental and Engineering Solutions, Trumbull, CT, entitled: "Asbestos Inspection Report, Cider Mill Pump Station, Glastonbury, CT, consisting of 10 pages. The Technical Data contained in such report upon whose accuracy Contractor may reasonably rely are laboratory analysis for asbestos samples.
 - b. Report dated August 14, 2017, prepared by Tattvam Environmental and Engineering Solutions, Trumbull, CT, entitled: "Lead Based Paint Screening Report, Cider Mill Pump Station, Glastonbury, CT, consisting of 8 pages. The Technical Data contained in such report upon whose accuracy Contractor may reasonably rely are laboratory analysis for lead based paint samples.
 - c. Report dated August 15, 2017, prepared by Tattvam Environmental and Engineering Solutions, Trumbull, CT, entitled: "PCB Inspection Report, Cider Mill Pump Station, Glastonbury, CT, consisting of 11 pages. The Technical Data contained in such report upon whose accuracy Contractor may reasonably rely are laboratory analysis for PCB samples.

Delete **Paragraph 5.06.I** of the General Conditions in its entirety.

Delete **Paragraph 5.06.J** of the General Conditions in its entirety and insert the following in its place:

To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend 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 failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. This indemnification obligation shall not include liability for damage arising out of bodily injury to persons or damage to property to the extent caused by or resulting from the negligence of the indemnitee, such indemnitee's agents or employees.

SC-6.02.D

Delete Paragraph 6.02.D of the General Conditions in its entirety.

SC-6.02.E

Delete Paragraph 6.02.E of the General Conditions in its entirety and replace it with the following:

Failure of Owner to demand such certificates or other evidence of the 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 the Contractor's obligation to obtain and maintain such insurance.

SC-6.03.H

Delete Paragraph 6.03.H of the General Conditions in its entirety and replace it with the following:

Contractor's professional liability insurance: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion.

SC-6.03.K CONTRACTOR'S INSURANCE

Add the following new paragraph immediately after Paragraph 6.03.J:

K. Contractor shall agree to maintain in force at all times during the Agreement the following minimum coverages and shall name the Town of Glastonbury as an Additional Insured on a primary and non-contributory basis to all policies except Workers Compensation and Professional

Liability. All policies should also include a Waiver of Subrogation. Insurance shall be written with Carriers approved in the State of Connecticut and with a minimum AM Best’s rating of “A-“VIII. In addition, all Carriers are subject to approval by the Town of Glastonbury.

		(Minimum Limits)
General Liability	Each Occurrence	\$1,000,000
	General Aggregate	\$2,000,000
	Products/Completed Operations Aggregate	\$2,000,000
Auto Liability	Combined Single Limit	
	Each Accident	\$1,000,000
	<ul style="list-style-type: none"> • Symbol 1/ Any Auto included 	
	Including Endorsements: <ul style="list-style-type: none"> • MCS-90 • Pollution Liability (CA9948) 	
Pollution Liability	Each Claim or Each Occurrence	\$1,000,000
	Aggregate	\$1,000,000
Professional Liability	Each Claim or Each Occurrence	\$2,000,000
	Aggregate	\$2,000,000
Umbrella/Excess Liability	Each Occurrence	\$10,000,000
	Aggregate	\$10,000,000

If any policy is written on a “Claims Made” basis, the policy must be continually renewed for a minimum of three (3) years from the completion date of this contract. If the policy is replaced and/or the retroactive date is changed, then the expiring policy must be endorsed to extend the reporting period for claims for the policy in effect during the contract for three (3) years from the completion date.

Workers’ Compensation and	WC Statutory Limits	
Employers’ Liability	EL Each Accident	\$1,000,000
	EL Disease Each Employee	\$1,000,000
	EL Disease Policy Limit	\$1,000,000

Original, completed Certificates of Insurance must be presented to the Town of Glastonbury prior to issuance of Agreement. Vendor agrees to provide replacement/renewal certificates at least 30 days prior to the expiration date of the policies. The Town of Glastonbury must be provided written notice within 30 days of any policy cancellation or reduction in required coverage.

The Contractor shall require each of its Subcontractors to comply with all of the foregoing insurance requirements and to provide evidence of such compliance to the Contractor prior to the commencement of any Work by such Subcontractor.

SC-6.05 PROPERTY INSURANCE

Delete Paragraph 6.05.A of the General Conditions in its entirety and replace it with the following:

The Owner shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as are acceptable to the Owner) The Owner shall have the right to adjust and settle any insured loss under this policy. The Owner shall pay for costs not covered because of the application of a policy deductible.

The Contractor shall be responsible for insuring its own tools, construction equipment, and other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor.

SC-6.06 WAIVER OF RIGHTS

Delete Paragraph 6.06 of the General Conditions in its entirety and replace it with the following:

- A. The builder's risk policy maintained by the Owner 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 insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the 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 policy and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, 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 or Contractor for the insureds, or otherwise payable under any policy so issued.
- B. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, 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 builder's risk insurance and any other property insurance applicable to the Work.

SC 6.07 RECEIPT AND APPLICATION OF PROPERTY INSURANCE PROCEEDS

Delete Paragraphs 6.07.A, 6.07.B and 6.07.C of the General Conditions in their entirety.

SC-7.01 SUPERVISION, SUPERINTENDENCE AND STANDARD OF CARE

Delete Paragraph 7.01 of the General Conditions in its entirety and replace it with the following:

SC-7.01 SUPERVISION SUPERINTENDENCE AND STANDARD OF CARE

Delete Paragraph 7.01 of the General Conditions in its entirety and replace it with the following:

7.01 Supervision, Superintendence and Standard of Care

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.

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.

C. Contractor's Standard of Care:

The Contractor shall be responsible for the performance of all of the Work (i) in a good and workmanlike manner; (ii) consistent and in accordance with the Contract Documents; (iii) consistent and in accordance with the instructions, guidance and direction of the Owner and Engineer; (iv) consistent and in accordance with the prevailing applicable professional or industry standards; (v) consistent and in accordance with sound practices; and (vi) as expeditiously as is consistent with the foregoing (such standards collectively, the "Contractor's Standard of Care"). The Contractor shall perform the Work as an independent contractor and shall exercise the Contractor's Standard of Care in performing all aspects of the Work and its obligations under the Contract Documents. All references in the Contract Documents to the knowledge, inference, reliance, awareness, determination, belief, observation, recognition or discovery of the Contractor or reference to any similar term shall include the knowledge, inference, reliance, awareness, determination, belief, observation, recognition the Contractor would have obtained or achieved upon the exercise of the Contractor's Standard of Care. The Contractor shall be responsible for exercise of the Contractor's Standard of Care by all others performing any component of the Work.

SC-7.02 LABOR; WORKING HOURS

Add the following sentence to the end of Paragraph 7.02.B of the General Conditions:

"Regular working hours shall be 7:00 a.m. to 5:00 p.m., Monday through Friday.."

SC-7.04 "OR EQUALS"

Amend the third sentence of Paragraph 7.04A by striking out the following words at the beginning of the sentence: "Unless the specifications or description contains or is followed by words reading that no like, equivalent, or 'or-equal' item is permitted".

Add a new paragraph SC-7.04.B.1 immediately after paragraph 7.04.B of the General Conditions, which is to read as follows:

1. It shall be Contractor's responsibility to coordinate all submittals to Engineer for approval to eliminate any conflicts which might arise due to the use of "or equal" items. Any additional costs incidental to the use of "or equal" items shall be paid by Contractor.

SC-7.05 SUBSTITUTES

Delete Section **7.05.D** of the General Conditions and replace with the following:

Reimbursement of Engineer's Cost: If the contract between the Owner and the Engineer entitles the Engineer to additional compensation for its services in connection with the review of substitutions proposed by the Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute, whether or not Engineer approves such 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.

Add a new paragraph 7.05.E.1 immediately after paragraph 7.05.E of the General Conditions, which is to read as follows:

1. It shall be Contractor's responsibility to coordinate all submittals to Engineer for approval to eliminate any conflicts which might arise due to the use of substitutes. Any additional costs incidental to the use of substitutes shall be paid by Contractor.

SC-7.06 CONCERNING SUBCONTRACTORS, SUPPLIERS, AND OTHERS

Delete Section 7.06.F of the General Conditions and replace it with the following:

If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work without previous objection by the Owner, the Contractor shall be entitled to an appropriate adjustment in Contract Price if the replacement subcontractor requires a higher subcontract price. Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

Add a new sentence to the end of Paragraph 7.06.K of the General Conditions to read as follows:

Owner or Engineer may furnish to any such Subcontractor, Supplier or other person or organization, to the extent practicable, information about amounts paid on their behalf to Contractor in accordance with Contractor's Applications for Payment.

Add a new Paragraph 7.06.P immediately after Paragraph 7.06.O of the General Conditions which is to read as follows:

Contracts between the Contractor and Subcontractors shall (1) require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the

Contractor, by the Contract Documents, assumes toward the Owner and Engineer, and (2) allow the Subcontractor the benefit of all rights, remedies and redress against the Contractor that the Contractor, by these Contract Documents, has against the Owner.

SC-7.07 Patent Fees and Royalties

Delete Section 7.07.B of the General Conditions in its entirety.

Delete Section 7.07.C of the General Conditions and replace it with the following:

To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend 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.

SC-7.08 PERMITS

Add a new paragraph immediately after Paragraph 7.08.A of the General Conditions which is to read as follows:

- B. The Contractor shall be responsible for obtaining a Building Permit and other permits and approvals as required from the Town of Glastonbury, CT. However, fees payable to the Town of Glastonbury, CT for such permits, if required, shall be paid directly by the Owner. The Contractor will be allowed no allowance for overhead and profit on fees paid to the Town of Glastonbury, CT. All costs associated with obtaining these permits and approvals (other than the fees paid directly to the Town of Glastonbury, CT) shall be included in the Contract Price.

SC-7.09 TAXES

Add a new paragraph immediately after Paragraph 7.09.A of the General Conditions:

- 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-7.10 LAWS AND REGULATIONS

Delete paragraph 7.10.B of the General Conditions and replace it with the following:

If Contractor performs any Work or takes any other action knowing or having reason to know that

it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify, defend 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 such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

SC-7.18 Indemnification

Delete paragraph 7.18.A. of the General Conditions in its entirety and replace it with the following:

To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify, defend, 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. This indemnification obligation shall not include liability for damage arising out of bodily injury to persons or damage to property to the extent caused by or resulting from the negligence of the indemnitee, such indemnitee's agents or employees.

SC-8.03 Legal Relationships

Delete subparagraph 8.03.D(2) of the General Conditions and replace it with the following:

(2) indemnify, defend 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 any such claims, and against all 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 damage, delay, disruption, or interference.

SC-8.04 CLAIMS BETWEEN CONTRACTORS

Add the following new paragraph immediately after Paragraph 8.03:

8.04 *Claims Between Contractors*

- A. Should Contractor cause damage to the work or property of any other contractor at the Site, or should any claim arising out of Contractor's performance of the Work at the Site be made by any other contractor against Contractor, Owner, or Engineer, then Contractor (without involving Owner, Engineer, or construction coordinator) shall

- either (1) remedy the damage, (2) agree to compensate the other contractor for remedy of the damage, or (3) remedy the damage and attempt to settle with such other contractor by agreement, or otherwise resolve the dispute by arbitration or at law.
- B. Contractor shall, to the fullest extent permitted by Laws and Regulations, indemnify, defend and hold harmless Owner, Engineer, and the officers, directors, partners, employees, agents and other consultants and subcontractors of each and any of them from and against all claims, costs, losses and damages (including, but not limited to, fees and charges of engineers, architects, attorneys, and other professionals and court and arbitration costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any other contractor against Owner, Engineer, or the officers, directors, partners, employees, agents and other consultants and subcontractors of either of them to the extent said claim is based on or arises out of the performance of the Work. Should another contractor cause damage to the Work or property of Contractor or should the performance of work by any other contractor at the Site give rise to any other Claim, Contractor shall not institute any action, legal or equitable, against Owner, or Engineer, or permit any action against either of them to be maintained and continued in its name or for its benefit in any court or before any arbiter which seeks to impose liability on or to recover damages from Owner or Engineer on account of any such damage or Claim.
- C. If Contractor is delayed at any time in performing or furnishing the Work by any act or neglect of another contractor, and Owner and Contractor are unable to agree as to the extent of any adjustment in Contract Times attributable thereto, Contractor may make a Claim for an extension of times in accordance with Article 11. An extension of the Contract Times shall be Contractor's exclusive remedy with respect to Owner and Engineer for any delay, disruption, interference, or hindrance caused by any other contractor. This paragraph does not prevent recovery from Owner or Engineer for activities that are their respective responsibilities.

SC-9 OWNER'S RESPONSIBILITIES

SC-9.01 COMMUNICATIONS TO CONTRACTOR

Delete Paragraph 9.01.A of the General Conditions and replace it with the following:

Except as otherwise provided in these General Conditions, Owner shall endeavor to issue all communications with the Contractor through the Engineer.

SC-9.11 EVIDENCE OF FINANCIAL ARRANGEMENTS

Delete Paragraph 9.11.A of the General Conditions and replace it with the following:

- A. Prior to the commencement of the Work, 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.

SC-9.12 SAFETY PROGRAM

Delete Paragraph 9.12.B of the General Conditions in its entirety.

SC-10 ENGINEER'S STATUS DURING CONSTRUCTION

Delete Paragraph 10.01.A of the General Conditions in its entirety and replace it with the following:

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 between the Engineer and the Owner.

SC-10.03 PROJECT REPRESENTATIVE

Add a new paragraph immediately after paragraph 10.03.A 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 required by the Owner. 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.
 - 3.0 The Engineer's appointment of a Resident Project Representative, and the Engineer's delegation to the Resident Project Representative of various responsibilities of the Engineer, does not modify or lessen in any respect the Engineer's responsibility to the Owner to perform all of Engineer's obligations under the Contract.

SC-11.04 CHANGE OF CONTRACT PRICE

Delete section 11.04.C.2.c. of the General Conditions and replace it with the following:

- 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 11.04.C.2.a and 11.04.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total aggregate fee to be paid by Owner shall be no greater than 15 percent of the actual net increase in the Cost of the Work arising from the change in the Work;

SC-11.07 Execution of Change Orders

Delete Section 11.07.B. of the General Conditions in its entirety.

SC-13.01 COST OF THE WORK

Delete Paragraph 13.01.B.5.c of the General Conditions in its entirety and insert the following in its place:

- c. Construction Equipment and Machinery:
 - (1) Rentals of all construction equipment and machinery, and the parts thereof, 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.
 - (2) Costs for equipment and machinery owned by Contractor will be paid at a rate shown for such equipment in the latest version of the RSMeans Construction Cost Manual. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs. Costs will include the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, shall cease to accrue when the use thereof is no longer necessary for the changed Work. Equipment or machinery with a value of less than \$1,000 will be considered small tools.

SC 13.03 UNIT PRICE WORK

Delete Paragraph 13.03.E of the General Conditions in its entirety and insert the following in its place:

- E. The unit price of an item of Unit Price Work may be subject to reevaluation and adjustment under the following conditions:
 1. if the portion of the initial Contract Price attributable to a particular item of Unit Price Work amounted to 20 percent or more of the Contract Price and the quantity of that particular item of Unit Price Work performed by Contractor

- differs by more than 20 percent from the quantity of such item included in the initial Contract Price; and
2. if there is no corresponding adjustment with respect to any other item of Work; and
 3. if Contractor believes that Contractor has incurred additional expense as a result thereof or if Owner believes that the quantity variation entitles Owner to an adjustment in the unit price, either Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Article 10 if the parties are unable to agree as to the effect of any such variations in the quantity of Unit Price Work performed.

SC 14.07 OWNER MAY CORRECT DEFECTIVE WORK

Delete the words "within a reasonable time" in the first sentence of Paragraph 14.07.A of the General Conditions, and replace with the words "seven days".

Delete the first sentence of Paragraph 14.07.B of the General Conditions.

SC-15.01 PROGRESS PAYMENTS

Delete Paragraph 15.01.B.2 of the General Conditions and replace it with the following:

Beginning with the second Application for Payment and continuing with each Application submitted thereafter, the Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied as provided in the previous Applications for Payment along with properly executed complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work from the Contractor and each Subcontractor and material supplier whose Work was included on the previous Application for Payment for which payment by Owner was made to the Contractor.

Add the following language at the end of Paragraph 15.01.B.3 of the General Conditions:

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

Add the following new Paragraph after Paragraph 15.01.B.3:

4. The Application for Payment form to be used on this Project is EJCDC C-620.

Delete 15.01.C.4 of the General Conditions and replace it with the following:

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, unless otherwise provided in the Engineer’s contract with the Owner, 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 money 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 with the exception of collecting the waivers from the Contractor, Subcontractors and suppliers under Paragraph 15.01.B.2.

Delete Paragraph 15.01.D.1 of the General Conditions in its entirety and insert the following in its place:

D. Payment Becomes Due

1. The Application for Payment with Engineer's recommendations will be presented to the Owner for review and consideration. If the Owner finds the Application for Payment acceptable and is in agreement with the Engineer's recommendations for payment, the Owner will pay the recommended amount (less any reduction under the provisions of Paragraph 15.01.E) to the Contractor within forty-five (45) days after the Application for Payment and Engineer's recommendations were received by the Owner.

SC-15.02 CONTRACTOR'S WARRANTY OF TITLE

Amend Paragraph 15.02.A of the General Conditions by striking out the following text: "no later than seven days after the time of payment by Owner" and insert "no later than the time of payment therefore by Owner."

Add two new paragraphs immediately after paragraph 15.02.A of the General Conditions which are to read as follows:

- B. No materials or supplies for the Work shall be purchased by Contractor or Subcontractor subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller. Contractor warrants that Contractor has good title to all materials and supplies used by Contractor in the Work, free from all liens, claims or encumbrances.
- C. Contractor shall indemnify, defend and save Owner harmless from all claims growing out of the lawful demands of Subcontractors, laborers, workmen, mechanics, material men, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary, incurred in the furtherance of the performance of this Contract. Contractor shall at Owner's request, furnish satisfactory evidence that all obligations of the nature hereinabove designated have been paid, discharged, or waived. If Contractor fails to do so, then Owner may, after having served written notice on the said Contractor either pay unpaid bills, of which Owner has written notice, direct, or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to Contractor shall be resumed, in accordance with the terms of this Contract, but in no event shall the provisions of this sentence be construed to impose any obligations upon Owner to either Contractor or Contractor's Surety. In paying any unpaid bills of the Contractor, Owner shall be deemed the agent of Contractor and any payment so made

by Owner, shall be considered as payment made under the Contract by Owner to Contractor and Owner shall not be liable to Contractor for any such payment made in good faith.

SC-15.03 SUBSTANTIAL COMPLETION

Add the following new subparagraph to Paragraph 15.03.B of the General Conditions:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, shall be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due the Contractor.

Add the following new Paragraph immediately after paragraph 15.03.F of the General Conditions, which is to read as follows:

- G. Engineer shall be entitled to withhold its certificate of Substantial Completion if Contractor has not brought all systems and subsystems that are part of the Work substantially complete to functioning condition to the satisfaction of the Owner; provided training to Owner to the satisfaction of the Owner on all operating systems that are part of the Work substantially complete; and provided all necessary documentation for operation and maintenance of all operating systems including, but not limited to, final manufacturer's operation and maintenance manuals.

SC-15.06 FINAL PAYMENT

Delete Paragraph 15.06.A.3 of the General Conditions and replace it with the following:

In addition to the foregoing, Contractor shall furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) 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 shall furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

Add the new paragraph immediately after paragraph 15.06.A.3 of the General Conditions, which is to read as follows:

4. Two (2) percent of the total Contract Price as reflected on the final Application for Payment shall be retained by Owner during the Correction Period described in Section 15.08.A. of these General Conditions. 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 15.06.D 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 Article 14 of the General Conditions.

SC-16.01 Owner May Suspend Work

Delete Paragraph 16.01.A.1 of the General Conditions and replace it with the following:

At any time and without cause, Owner may suspend the Work or any portion thereof by written notice to Contractor and Engineer. If the Owner does not issue a written notice to resume the Work within 90 days thereafter, Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

SC 16.02 OWNER MAY TERMINATE FOR CAUSE

Add a new phrase immediately after paragraph 16.02.A.4 of the General Conditions which is to read as follows:

5. If Contractor abandons the Work, or sublets this Contract or any part thereof, without the previous written consent of Owner, or if the Contract or any claim thereunder shall be assigned by Contractor otherwise than as herein specified.

Delete Paragraph 16.02.E of the General Conditions and replace with the following:

If Owner proceeds as provided in Paragraph 16.02.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 the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be retained by the Owner. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds 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 unless otherwise required by applicable law.

SC-16.03 OWNER MAY TERMINATE FOR CONVENIENCE

Delete Paragraph 16.03.A.2 of the General Conditions *in its entirety*.

SC-16.04 CONTRACTOR MAY STOP WORK OR TERMINATE

Add into the fifth line of Paragraph 16.04.B of the General Conditions after the words “including interest thereon” and before the period the following:

but only to the extent to which the Contractor is entitled to interest on past due payments under the Contract Documents.

SC 17.02 ATTORNEY'S FEES

Add the following new paragraph immediately after Paragraph 17.01 of the General Conditions:

17.02 Attorneys' Fees

For any matter subject to final resolution under this Article, the prevailing party shall be entitled to an award of its attorneys' fees incurred in the final resolution proceedings, in an equitable amount to be determined in the discretion of the arbitrator, arbitration panel, or other arbiter of the matter subject to final resolution, taking into account the parties' initial demand or defense positions in comparison with the final result. Dispute resolution shall be mitigation or arbitration.

SC-18 MISCELLANEOUS

SC-18.01 GIVING NOTICE

Delete Paragraph 18.01 of the General Conditions and replace with the following:

18.01 Giving Notice

A. Whenever any provision of the Contract Documents requires the giving of written notice by one party to the Contract to the other, it will be deemed to have been validly given if delivered in person, by a commercial courier service, or sent by registered or certified mail, postage prepaid, to the applicable individual identified below as the recipient for notice purposes:

Owner:

_____ [name, address, telephone number and email address]

Contractor:

_____ [name, address, telephone number and email address]

SC-18.09 WAGE RATES

Add new paragraphs immediately after paragraph 18.08.A of the General Conditions which reads as follows:

18.09 *Wage Rates*

A. To the extent required under Section 31-53 of the Connecticut General Statutes, 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 such Section 31-53, 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. To the extent required pursuant to Connecticut General Statute Section 31-53b, the Contractor shall furnish proof, and shall cause its Subcontractors to 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 46 or, in the case of telecommunications employees, has completed at least ten hours of training in accordance with 29 CFR 1910.268, and that any plumber or electrician subject to the continuing education requirements of section 20-334d, who 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 five or more years prior to the date such electrician or plumber begins work on such public works project, has completed a supplemental refresher training course of at least four hours in duration in construction safety and health taught by a federal Occupational Safety and Health Administration authorized trainer.

C. 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 the Contract Documents. Copies of the wage schedules are included in SC-32 of these Supplementary Conditions.

D. 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.

E. 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.

F. 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.

END OF SECTION

SECTION SC-32WAGE RATES

Wage rates apply to this project. The Wage Rates are included in this section. 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 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



Opportunity * Guidance * Support



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.

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.

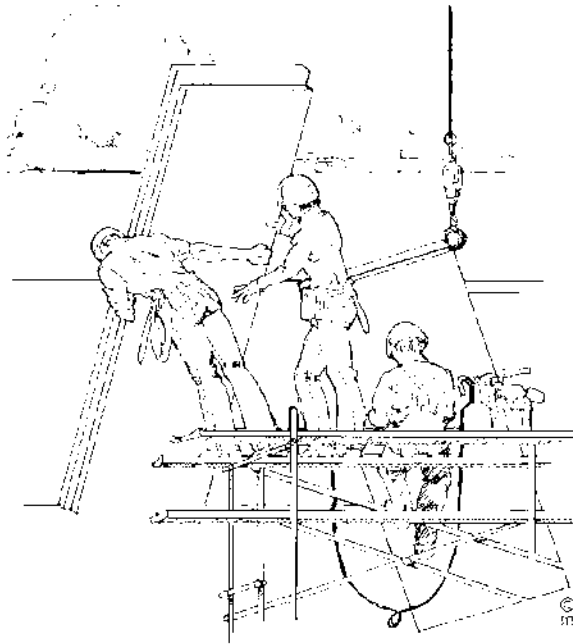
~NOTICE~

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.

 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.

PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS

WEEKLY PAYROLL

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

In accordance with Connecticut General Statutes, 31-53 Certified Payrolls with a statement of compliance shall be submitted monthly to the contracting agency.

CONTRACTOR NAME AND ADDRESS: _____

SUBCONTRACTOR NAME & ADDRESS _____

WORKER'S COMPENSATION INSURANCE CARRIER _____

PAYROLL NUMBER _____ Week-Ending Date _____ PROJECT NAME & ADDRESS _____

POLICY # _____

EFFECTIVE DATE: _____

EXPIRATION DATE: _____

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 WITH-HOLDING	STATE WITH-HOLDING	LIST OTHER			
				HOURS WORKED EACH DAY							Total O/T Hours	TOTAL FRINGE BENEFIT PLAN CASH									
												\$	1. \$								
												Base Rate	2. \$								
													3. \$								
												\$	4. \$								
												Cash Fringe	5. \$								
													6. \$								

***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 contract or 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)

PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS

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 WITH- HOLDING	STATE WITH- HOLDING	OTHER					
				Trade License Type & Number - OSHA 10 Certification Number	HOURS WORKED EACH DAY							Total O/T Hours	TOTAL FRINGE BENEFIT PLAN CASH	1. \$	2. \$	3. \$	4. \$	5. \$	6. \$				

*IF REQUIRED

[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.

PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS											Connecticut Department of Labor Wage and Workplace Standards Division 200 Folly Brook Blvd. Wethersfield, CT 06109									
In accordance with Connecticut General Statutes, 31-53 Certified Payrolls with a statement of compliance shall be submitted monthly to the contracting agency.											WEEKLY PAYROLL									
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 Travelers Insurance Company POLICY # #BAC8888928 EFFECTIVE DATE: 1/1/09 EXPIRATION DATE: 12/31/09									
PAYROLL NUMBER	Week-Ending Date	PROJECT NAME & ADDRESS									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
		DAY AND DATE							HOURS WORKED EACH DAY						FICA	WITH-HOLDING	WITH-HOLDING	LIST OTHER		
PERSON/WORKER, ADDRESS and SECTION	APPR RATE %	MALE/FEMALE AND RACE*	WORK CLASSIFICATION	S	M	T	W	TH	F	S	Total O/T Hours	TOTAL FRINGE BENEFIT PLAN CASH								
1	9/26/09	DOT 105-296, Route 82																		
Robert Craft 81 Maple Street Willimantic, CT 06226		M/C	Electrical Lineman E-1 1234567 Owner OSHA 123456		8	8	8	8	8		S-TIME 40 O-TIME	\$ 30.75 Base Rate \$ 8.82 Cash Fringe	1. \$ 5.80 2. \$ 3. \$ 2.01 4. \$ 5. \$ 6. \$	\$1,582.80				P-xxxx	\$1,582.80	#123 \$ xxx.xx
Ronald Jones 212 Elm Street Norwich, CT 06360	65%	M/B	Electrical Apprentice OSHA 234567		8	8	8	8	8		S-TIME 40 O-TIME	\$ 19.99 Base Rate \$ 16.63 Cash Fringe	1. \$ 2. \$ 3. \$ 4. \$ 5. \$ 6. \$	\$1,464.80	xx.xx	xxx.xx	xx.xx	G-xxx	\$1,464.80	#124 \$xxx.xx
Franklin T. Smith 234 Washington Rd. New London, CT 06320 SECTION B		M/H	Project Manager			8					S-TIME 8 O-TIME	\$ Base Rate \$ Cash Fringe	1. \$ 2. \$ 3. \$ 4. \$ 5. \$ 6. \$	\$1,500.00	xx.xx	xx.xx	xx.xx	M-xx.x		#125 xxx.xx
											S-TIME O-TIME	\$ Base Rate \$ Cash Fringe	1. \$ 2. \$ 3. \$ 4. \$ 5. \$ 6. \$							

7/13/2009 *IF REQUIRED
WWS-CP1

*SEE REVERSE SIDE

PAGE NUMBER 1 OF 2

OSHA 10 ~ATTACH CARD TO 1ST CERTIFIED PAYROLL

***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 Blue Cross 4) Disability _____
- 2) Pension or retirement _____ 5) Vacation, holiday _____
- 3) 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:

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 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 contract or 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.

Robert Craft owner 10/2/09
 (Signature) (Title) 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 wage requirements defined in Connecticut General Statutes Section 31-53.

Robert Craft owner 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-CP1 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**

**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.

Project: Cider Mill Sewer Pump Station Upgrade

**Minimum Rates and Classifications
for Building Construction**

ID# : B 25641

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

By virtue of the authority vested in the Labor Commissioner under provisions of Section 31-53 of the General Statutes of Connecticut, as amended, the following are declared to be the prevailing rates and welfare payments and will apply only where the contract is advertised for bid within 20 days of the date on which the rates are established. Any contractor or subcontractor not obligated by agreement to pay to the welfare and pension fund shall pay this amount to each employee as part of his/her hourly wages.

Project Number:

Project Town: Glastonbury

State#:

FAP#:

Project: Cider Mill Sewer Pump Station Upgrade

CLASSIFICATION	Hourly Rate	Benefits
1a) Asbestos Worker/Insulator (Includes application of insulating materials, protective coverings, coatings, & finishes to all types of mechanical systems; application of firestopping material for wall openings & penetrations in walls, floors, ceilings	38.25	27.96
<hr/>		
1b) Asbestos/Toxic Waste Removal Laborers: Asbestos removal and encapsulation (except its removal from mechanical systems which are not to be scrapped), toxic waste removers, blasters.**See Laborers Group 7**		
<hr/>		
1c) Asbestos Worker/Heat and Frost Insulator	40.21	29.30

As of: Tuesday, February 05, 2019

Project: Cider Mill Sewer Pump Station Upgrade

2) Boilermaker	38.34	26.01
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3a) Bricklayer, Cement Mason, Concrete Finisher (including caulking), Stone Masons	33.48	32.06 + a
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3b) Tile Setter	34.90	25.87
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3c) Terrazzo Mechanics and Marble Setters	31.69	22.35
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3d) Tile, Marble & Terrazzo Finishers	26.70	21.75
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3e) Plasterer	33.48	32.06
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As of: Tuesday, February 05, 2019

Project: Cider Mill Sewer Pump Station Upgrade

-----LABORERS-----

4) Group 1: Laborers (common or general), acetylene burners, carpenter tenders, concrete specialists, wrecking laborers, fire watchers.	30.05	20.10
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4a) Group 2: Mortar mixers, plaster tender, power buggy operators, powdermen, fireproofers/mixer/nozzlemans (Person running mixer and spraying fireproof only).	30.30	20.10
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4b) Group 3: Jackhammer operators/pavement breaker, mason tender (brick), mason tender (cement/concrete), forklift operators and forklift operators (masonry).	30.55	20.10
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4c) **Group 4: Pipelayers (Installation of water, storm drainage or sewage lines outside of the building line with P6, P7 license) (the pipelayer rate shall apply only to one or two employees of the total crew whose primary task is to actually perform the mating of pipe sections) P6 and P7 rate is \$26.80.	30.55	20.10
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4d) Group 5: Air track operator, sand blaster and hydraulic drills.	30.55	20.10
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Project: Cider Mill Sewer Pump Station Upgrade

4e) Group 6: Blasters, nuclear and toxic waste removal.	31.80	20.10
---	-------	-------

4f) Group 7: Asbestos/lead removal and encapsulation (except it's removal from mechanical systems which are not to be scrapped).	31.05	20.10
--	-------	-------

4g) Group 8: Bottom men on open air caisson, cylindrical work and boring crew.	28.38	20.10
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4h) Group 9: Top men on open air caisson, cylindrical work and boring crew.	27.86	20.10
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4i) Group 10: Traffic Control Signalman	16.00	20.10
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5) Carpenter, Acoustical Ceiling Installation, Soft Floor/Carpet Laying, Metal Stud Installation, Form Work and Scaffold Building, Drywall Hanging, Modular-Furniture Systems Installers, Lathers, Piledrivers, Resilient Floor Layers.	32.60	25.34
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As of: Tuesday, February 05, 2019

Project: Cider Mill Sewer Pump Station Upgrade

5a) Millwrights 33.14 25.74

6) Electrical Worker (including low voltage wiring) (Trade License required: E1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9) 40.00 25.97+3% of gross wage

7a) Elevator Mechanic (Trade License required: R-1,2,5,6) 51.71 32.645+a+b

-----LINE CONSTRUCTION-----

Groundman 26.50 6.5% + 9.00

Linemen/Cable Splicer 48.19 6.5% + 22.00

As of: Tuesday, February 05, 2019

Project: Cider Mill Sewer Pump Station Upgrade

8) Glazier (Trade License required: FG-1,2) 37.18 21.05 + a

9) Ironworker, Ornamental, Reinforcing, Structural, and Precast Concrete Erection 35.47 35.14 + a

----OPERATORS----

Group 1: Crane handling or erecting structural steel or stone, hoisting engineer 2 drums or over, front end loader (7 cubic yards or over), work boat 26 ft. and over and Tunnel Boring Machines. (Trade License Required) 39.55 24.30 + a

Group 2: Cranes (100 ton rate capacity and over); Excavator over 2 cubic yards; Piledriver (\$3.00 premium when operator controls hammer); Bauer Drill/Caisson. (Trade License Required) 39.23 24.30 + a

Group 3: Excavator; Backhoe/Excavator under 2 cubic yards; Cranes (under 100 ton rated capacity), Grader/Blade; Master Mechanic; Hoisting Engineer (all types of equipment where a drum and cable are used to hoist or drag material regardless of motive power of operation), Rubber Tire Excavator (Drott-1085 or similar); Grader Operator; Bulldozer Fine Grade. (slopes, shaping, laser or GPS, etc.). (Trade License Required) 38.49 24.30 + a

Project: Cider Mill Sewer Pump Station Upgrade

Group 4: Trenching Machines; Lighter Derrick; Concrete Finishing Machine; CMI Machine or Similar; Koehring Loader (Skooper).	38.10	24.30 + a
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Group 5: Specialty Railroad Equipment; Asphalt Paver; Asphalt Reclaiming Machine; Line Grinder; Concrete Pumps; Drills with Self Contained Power Units; Boring Machine; Post Hole Digger; Auger; Pounder; Well Digger; Milling Machine (over 24" Mandrell)	37.51	24.30 + a
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Group 5 continued: Side Boom; Combination Hoe and Loader; Directional Driller; Pile Testing Machine.	37.51	24.30 + a
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Group 6: Front End Loader (3 up to 7 cubic yards); Bulldozer (rough grade dozer).	37.20	24.30 + a
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Group 7: Asphalt roller, concrete saws and cutters (ride on types), vermeer concrete cutter, Stump Grinder; Scraper; Snooper; Skidder; Milling Machine (24" and under Mandrell).	36.86	24.30 + a
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Group 8: Mechanic, grease truck operator, hydroblaster; barrier mover; power stone spreader; welding; work boat under 26 ft.; transfer machine.	36.46	24.30 + a
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Project: Cider Mill Sewer Pump Station Upgrade

Group 9: Front end loader (under 3 cubic yards), skid steer loader regardless of attachments, (Bobcat or Similar): forklift, power chipper; landscape equipment (including Hydroseeder).	36.03	24.30 + a
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Group 10: Vibratory hammer; ice machine; diesel and air, hammer, etc.	33.99	24.30 + a
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Group 11: Conveyor, earth roller, power pavement breaker (whiphammer), robot demolition equipment.	33.99	24.30 + a
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Group 12: Wellpoint operator.	33.93	24.30 + a
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Group 13: Compressor battery operator.	33.35	24.30 + a
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Group 14: Elevator operator; tow motor operator (solid tire no rough terrain).	32.21	24.30 + a
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As of: Tuesday, February 05, 2019

Project: Cider Mill Sewer Pump Station Upgrade

Group 15: Generator Operator; Compressor Operator; Pump Operator; Welding Machine Operator; Heater Operator.	31.80	24.30 + a
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Group 16: Maintenance Engineer/Oiler.	31.15	24.30 + a
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Group 17: Portable asphalt plant operator; portable crusher plant operator; portable concrete plant operator.	35.46	24.30 + a
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Group 18: Power safety boat; vacuum truck; zim mixer; sweeper; (Minimum for any job requiring a CDL license).	33.04	24.30 + a
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-----PAINTERS (Including Drywall Finishing)-----

10a) Brush and Roller	33.62	21.05
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Project: Cider Mill Sewer Pump Station Upgrade

10b) Taping Only/Drywall Finishing	34.37	21.05
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10c) Paperhanger and Red Label	34.12	21.05
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10e) Blast and Spray	36.62	21.05
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11) Plumber (excluding HVAC pipe installation) (Trade License required: P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2)	42.62	31.21
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12) Well Digger, Pile Testing Machine	37.26	24.05 + a
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13) Roofer (composition)	36.70	19.85
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As of: Tuesday, February 05, 2019

Project: Cider Mill Sewer Pump Station Upgrade

14) Roofer (slate & tile)	37.20	19.85
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15) Sheetmetal Worker (Trade License required for HVAC and Ductwork: SM-1,SM-2,SM-3,SM-4,SM-5,SM-6)	37.50	36.79
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16) Pipefitter (Including HVAC work) (Trade License required: S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4, G-1, G-2, G-8 & G-9)	42.62	31.21
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-----TRUCK DRIVERS-----

17a) 2 Axle	29.13	23.33 + a
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17b) 3 Axle, 2 Axle Ready Mix	29.23	23.33 + a
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As of: **Tuesday, February 05, 2019**

Project: Cider Mill Sewer Pump Station Upgrade

17c) 3 Axle Ready Mix	29.28	23.33 + a
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17d) 4 Axle, Heavy Duty Trailer up to 40 tons	29.33	23.33 + a
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17e) 4 Axle Ready Mix	29.38	23.33 + a
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17f) Heavy Duty Trailer (40 Tons and Over)	29.58	23.33 + a
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17g) Specialized Earth Moving Equipment (Other Than Conventional Type on-the-Road Trucks and Semi-Trailers, Including Euclids)	29.38	23.33 + a
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18) Sprinkler Fitter (Trade License required: F-1,2,3,4)	43.92	15.84 + a
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As of: Tuesday, February 05, 2019

Project: Cider Mill Sewer Pump Station Upgrade

19) Theatrical Stage Journeyman	25.76	7.34
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Project: Cider Mill Sewer Pump Station Upgrade

Welders: Rate for craft to which welding is incidental.

**Note: Hazardous waste removal work receives additional \$1.25 per hour for truck drivers.*

***Note: Hazardous waste premium \$3.00 per hour over classified rate*

ALL Cranes: When crane operator is operating equipment that requires a fully licensed crane operator to operate he receives an extra \$4.00 premium in addition to the hourly wage rate and benefit contributions:

1) Crane handling or erecting structural steel or stone; hoisting engineer (2 drums or over)

2) Cranes (100 ton rate capacity and over) Bauer Drill/Caisson

3) Cranes (under 100 ton rated capacity)

Crane with 150 ft. boom (including jib) - \$1.50 extra

Crane with 200 ft. boom (including jib) - \$2.50 extra

Crane with 250 ft. boom (including jib) - \$5.00 extra

Crane with 300 ft. boom (including jib) - \$7.00 extra

Crane with 400 ft. boom (including jib) - \$10.00 extra

All classifications that indicate a percentage of the fringe benefits must be calculated at the percentage rate times the "base hourly rate".

Apprentices duly registered under the Commissioner of Labor's regulations on "Work Training Standards for Apprenticeship and Training Programs" Section 31-51-d-1 to 12, are allowed to be paid the appropriate percentage of the prevailing journeymen hourly base and the full fringe benefit rate, providing the work site ratio shall not be less than one full-time journeyman instructing and supervising the work of each apprentice in a specific trade.

The Prevailing wage rates applicable to this project are subject to annual adjustments each July 1st for the duration of the project.

Each contractor 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 website.

The annual adjustments will be posted on the Department of Labor's Web page: www.ct.gov/dol. 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.

Contracting Agencies are under no obligation pursuant to State labor law to pay any increase due to the annual adjustment provision.

As of: Tuesday, February 05, 2019

Project: Cider Mill Sewer Pump Station Upgrade

Effective October 1, 2005 - Public Act 05-50: any person performing the work of any mechanic, laborer, or worker shall be paid prevailing wage

All Person who perform work ON SITE must be paid prevailing wage for the appropriate mechanic, laborer, or worker classification.

All certified payrolls must list the hours worked and wages paid to All Persons who perform work ON SITE regardless of their ownership i.e.: (Owners, Corporate Officers, LLC Members, Independent Contractors, et. al)

Reporting and payment of wages is required regardless of any contractual relationship alleged to exist between the contractor and such person.

~~Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clause (29 CFR 5.5 (a) (1) (ii)).

Please direct any questions which you may have pertaining to classification of work and payment of prevailing wages to the Wage and Workplace Standards Division, telephone (860)263-6790.

As of: Tuesday, February 05, 2019

Project: Cider Mill Sewer Pump Station Upgrade

**Minimum Rates and Classifications
for Heavy/Highway Construction**

ID#: H 25641

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

By virtue of the authority vested in the Labor Commissioner under provisions of Section 31-53 of the General Statutes of Connecticut, as amended, the following are declared to be the prevailing rates and welfare payments and will apply only where the contract is advertised for bid within 20 days of the date on which the rates are established. Any contractor or subcontractor not obligated by agreement to pay to the welfare and pension fund shall pay this amount to each employee as part of his/her hourly wages.

Project Number:

Project Town: Glastonbury

FAP Number:

State Number:

Project: Cider Mill Sewer Pump Station Upgrade

CLASSIFICATION

Hourly Rate

Benefits

01) Asbestos/Toxic Waste Removal Laborers: Asbestos removal and encapsulation (except its removal from mechanical systems which are not to be scrapped), toxic waste removers, blasters. **See Laborers Group 5 and 7**

1) Boilermaker

33.79

34% + 8.96

1a) Bricklayer, Cement Masons, Cement Finishers, Plasterers, Stone Masons

33.48

31.66

2) Carpenters, Piledrivermen

32.60

25.34

As of:

Tuesday, February 05, 2019

Project: Cider Mill Sewer Pump Station Upgrade

2a) Diver Tenders	32.60	25.34
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3) Divers	41.06	25.34
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03a) Millwrights	33.14	25.74
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4) Painters: (Bridge Construction) Brush, Roller, Blasting (Sand, Water, etc.), Spray	49.75	21.05
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4a) Painters: Brush and Roller	33.62	21.05
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4b) Painters: Spray Only	36.62	21.05
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4c) Painters: Steel Only	35.62	21.05
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Project: Cider Mill Sewer Pump Station Upgrade

4d) Painters: Blast and Spray	36.62	21.05
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4e) Painters: Tanks, Tower and Swing	35.62	21.05
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5) Electrician (Trade License required: E-1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9)	40.00	25.97+3% of gross wage
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6) Ironworkers: Ornamental, Reinforcing, Structural, and Precast Concrete Erection	35.47	35.14 + a
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7) Plumbers (Trade License required: (P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2) and Pipefitters (Including HVAC Work) (Trade License required: S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4 G-1, G-2, G-8, G-9)	42.62	31.21
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---LABORERS----

8) Group 1: Laborer (Unskilled), Common or General, acetylene burner, concrete specialist	30.05	20.10
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Project: Cider Mill Sewer Pump Station Upgrade

9) Group 2: Chain saw operators, fence and guard rail erectors, pneumatic tool operators, powdermen	30.30	20.10
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10) Group 3: Pipelayers	30.55	20.10
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11) Group 4: Jackhammer/Pavement breaker (handheld); mason tenders (cement/concrete), catch basin builders, asphalt rakers, air track operators, block paver, curb setter and forklift operators	30.55	20.10
<hr/>		
12) Group 5: Toxic waste removal (non-mechanical systems)	32.05	20.10
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13) Group 6: Blasters	31.80	20.10
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Group 7: Asbestos/lead removal, non-mechanical systems (does not include leaded joint pipe)	31.05	20.10
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Group 8: Traffic control signalmen	16.00	20.10
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Project: Cider Mill Sewer Pump Station Upgrade

Group 9: Hydraulic Drills	29.30	18.90
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---LABORERS (TUNNEL CONSTRUCTION, FREE AIR). Shield Drive and
Liner Plate Tunnels in Free Air.----

13a) Miners, Motormen, Mucking Machine Operators, Nozzle Men, Grout Men, Shaft & Tunnel Steel & Rodmen, Shield & Erector, Arm Operator, Cable Tenders	32.22	20.10 + a
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13b) Brakemen, Trackmen	31.28	20.10 + a
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---CLEANING, CONCRETE AND CAULKING TUNNEL----

14) Concrete Workers, Form Movers, and Strippers	31.28	20.10 + a
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15) Form Erectors	31.60	20.10 + a
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Project: Cider Mill Sewer Pump Station Upgrade

---ROCK SHAFT LINING, CONCRETE, LINING OF SAME AND TUNNEL
IN FREE AIR:----

16) Brakemen, Trackmen, Tunnel Laborers, Shaft Laborers	31.28	20.10 + a
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17) Laborers Topside, Cage Tenders, Bellman	31.17	20.10 + a
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18) Miners	32.22	20.10 + a
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---TUNNELS, CAISSON AND CYLINDER WORK IN COMPRESSED
AIR: ----

18a) Blaster	38.53	20.10 + a
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19) Brakemen, Trackmen, Groutman, Laborers, Outside Lock Tender, Gauge Tenders	38.34	20.10 + a
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Project: Cider Mill Sewer Pump Station Upgrade

20) Change House Attendants, Powder Watchmen, Top on Iron Bolts	36.41	20.10 + a
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21) Mucking Machine Operator	39.11	20.10 + a
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---TRUCK DRIVERS---(*see note below)

Two axle trucks	29.13	23.33 + a
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Three axle trucks; two axle ready mix	29.23	23.33 + a
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Three axle ready mix	29.28	23.33 + a
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Four axle trucks, heavy duty trailer (up to 40 tons)	29.33	23.33 + a
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Project: Cider Mill Sewer Pump Station Upgrade

Four axle ready-mix	29.38	23.33 + a
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Heavy duty trailer (40 tons and over)	29.58	23.33 + a
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Specialized earth moving equipment other than conventional type on-the road trucks and semi-trailer (including Euclids)	29.38	23.33 + a
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---POWER EQUIPMENT OPERATORS---		
<hr/>		
Group 1: Crane handling or erecting structural steel or stone, hoisting engineer (2 drums or over), front end loader (7 cubic yards or over), Work Boat 26 ft. & Over, Tunnel Boring Machines. (Trade License Required)	39.55	24.30 + a
<hr/>		
Group 2: Cranes (100 ton rate capacity and over); Excavator over 2 cubic yards; Piledriver (\$3.00 premium when operator controls hammer); Bauer Drill/Caisson. (Trade License Required)	39.23	24.30 + a
<hr/>		
Group 3: Excavator/Backhoe under 2 cubic yards; Cranes (under 100 ton rated capacity), Gradall; Master Mechanic; Hoisting Engineer (all types of equipment where a drum and cable are used to hoist or drag material regardless of motive power of operation), Rubber Tire Excavator (Drott-1085 or similar); Grader Operator; Bulldozer Fine Grade (slopes, shaping, laser or GPS, etc.). (Trade License Required)	38.49	24.30 + a
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Project: Cider Mill Sewer Pump Station Upgrade

Group 4: Trenching Machines; Lighter Derrick; Concrete Finishing Machine; CMI Machine or Similar; Koehring Loader (Skooper)	38.10	24.30 + a
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Group 5: Specialty Railroad Equipment; Asphalt Paver; Asphalt Spreader; Asphalt Reclaiming Machine; Line Grinder; Concrete Pumps; Drills with Self Contained Power Units; Boring Machine; Post Hole Digger; Auger; Pounder; Well Digger; Milling Machine (over 24" Mandrell)	37.51	24.30 + a
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Group 5 continued: Side Boom; Combination Hoe and Loader; Directional Driller.	37.51	24.30 + a
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Group 6: Front End Loader (3 up to 7 cubic yards); Bulldozer (rough grade dozer).	37.20	24.30 + a
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Group 7: Asphalt Roller; Concrete Saws and Cutters (ride on types); Vermeer Concrete Cutter; Stump Grinder; Scraper; Snooper; Skidder; Milling Machine (24" and Under Mandrel).	36.86	24.30 + a
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Group 8: Mechanic, Grease Truck Operator, Hydroblaster, Barrier Mover, Power Stone Spreader; Welder; Work Boat under 26 ft.; Transfer Machine.	36.46	24.30 + a
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Group 9: Front End Loader (under 3 cubic yards), Skid Steer Loader regardless of attachments (Bobcat or Similar); Fork Lift, Power Chipper; Landscape Equipment (including hydroseeder).	36.03	24.30 + a
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Project: Cider Mill Sewer Pump Station Upgrade

Group 10: Vibratory Hammer, Ice Machine, Diesel and Air Hammer, etc. 33.99 24.30 + a

Group 11: Conveyor, Earth Roller; Power Pavement Breaker (whiphammer), Robot Demolition Equipment. 33.99 24.30 + a

Group 12: Wellpoint Operator. 33.93 24.30 + a

Group 13: Compressor Battery Operator. 33.35 24.30 + a

Group 14: Elevator Operator; Tow Motor Operator (Solid Tire No Rough Terrain). 32.21 24.30 + a

Group 15: Generator Operator; Compressor Operator; Pump Operator; Welding Machine Operator; Heater Operator. 31.80 24.30 + a

Group 16: Maintenance Engineer/Oiler 31.15 24.30 + a

Project: Cider Mill Sewer Pump Station Upgrade

Group 17: Portable asphalt plant operator; portable crusher plant operator; portable concrete plant operator.	35.46	24.30 + a
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Group 18: Power Safety Boat; Vacuum Truck; Zim Mixer; Sweeper; (minimum for any job requiring CDL license).	33.04	24.30 + a
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**NOTE: SEE BELOW

---LINE CONSTRUCTION---(Railroad Construction and Maintenance)---

20) Lineman, Cable Splicer, Technician	48.19	6.5% + 22.00
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21) Heavy Equipment Operator	42.26	6.5% + 19.88
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22) Equipment Operator, Tractor Trailer Driver, Material Men	40.96	6.5% + 19.21
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Project: Cider Mill Sewer Pump Station Upgrade

23) Driver Groundmen	26.50	6.5% + 9.00
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23a) Truck Driver	40.96	6.5% + 17.76
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---LINE CONSTRUCTION---

24) Driver Groundmen	30.92	6.5% + 9.70
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25) Groundmen	22.67	6.5% + 6.20
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26) Heavy Equipment Operators	37.10	6.5% + 10.70
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27) Linemen, Cable Splicers, Dynamite Men	41.22	6.5% + 12.20
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Project: Cider Mill Sewer Pump Station Upgrade

28) Material Men, Tractor Trailer Drivers, Equipment Operators

35.04

6.5% + 10.45

As of:

Tuesday, February 05, 2019

Project: Cider Mill Sewer Pump Station Upgrade

Welders: Rate for craft to which welding is incidental.

**Note: Hazardous waste removal work receives additional \$1.25 per hour for truck drivers.*

***Note: Hazardous waste premium \$3.00 per hour over classified rate*

ALL Cranes: When crane operator is operating equipment that requires a fully licensed crane operator to operate he receives an extra \$4.00 premium in addition to the hourly wage rate and benefit contributions:

1) Crane handling or erecting structural steel or stone; hoisting engineer (2 drums or over)

2) Cranes (100 ton rate capacity and over) Bauer Drill/Caisson

3) Cranes (under 100 ton rated capacity)

Crane with 150 ft. boom (including jib) - \$1.50 extra

Crane with 200 ft. boom (including jib) - \$2.50 extra

Crane with 250 ft. boom (including jib) - \$5.00 extra

Crane with 300 ft. boom (including jib) - \$7.00 extra

Crane with 400 ft. boom (including jib) - \$10.00 extra

All classifications that indicate a percentage of the fringe benefits must be calculated at the percentage rate times the "base hourly rate".

Apprentices duly registered under the Commissioner of Labor's regulations on "Work Training Standards for Apprenticeship and Training Programs" Section 31-51-d-1 to 12, are allowed to be paid the appropriate percentage of the prevailing journeymen hourly base and the full fringe benefit rate, providing the work site ratio shall not be less than one full-time journeyman instructing and supervising the work of each apprentice in a specific trade.

~~Connecticut General Statute Section 31-55a: Annual Adjustments to wage rates by contractors doing state work ~~

The Prevailing wage rates applicable to this project are subject to annual adjustments each July 1st for the duration of the project.

Each contractor 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 website.

The annual adjustments will be posted on the Department of Labor's Web page: www.ct.gov/dol.

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.

Contracting Agencies are under no obligation pursuant to State labor law to pay any increase due to the annual adjustment provision.

As of: Tuesday, February 05, 2019

Project: Cider Mill Sewer Pump Station Upgrade

Effective October 1, 2005 - Public Act 05-50: any person performing the work of any mechanic, laborer, or worker shall be paid prevailing wage

All Person who perform work ON SITE must be paid prevailing wage for the appropriate mechanic, laborer, or worker classification.

All certified payrolls must list the hours worked and wages paid to All Persons who perform work ON SITE regardless of their ownership i.e.: (Owners, Corporate Officers, LLC Members, Independent Contractors, et. al)

Reporting and payment of wages is required regardless of any contractual relationship alleged to exist between the contractor and such person.

~~Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clause (29 CFR 5.5 (a) (1) (ii)).

Please direct any questions which you may have pertaining to classification of work and payment of prevailing wages to the Wage and Workplace Standards Division, telephone (860)263-6790.

As of: Tuesday, February 05, 2019

SECTION SC-41

TOWN OF GLASTONBURY AFFIRMATIVE ACTION STATEMENT

AFFIRMATIVE ACTION STATEMENT

NOTE: IF YOUR COMPANY HAS LESS THAN 10 EMPLOYEES, OR HAS COMPLETED THIS SAME FORM WITHIN 1 YEAR, YOU MAY DISREGARD THE FOLLOWING EQUAL EMPLOYMENT/AFFIRMATION ACTION SECTION, EXCEPT AS NOTED.

- OR: (1) The number of employees _____
- (2) Completed this form within one year _____ Yes _____ No

FOR SEALED BIDS: If your company has completed this form within one year please forward a photocopy of the initial form with your bid. If significant changes have taken place within the past year; please update the information on this form.

REQUIREMENT: Any vendor/bidder seeking to do business with the Town of Glastonbury must, upon request, supply the Town and/or the Glastonbury Human Relations Commission with any information concerning the Affirmative Action/Equal Employment practices of the vendor/bidder, which the Town and/or Commission deems necessary in fulfilling its charge. Failure to supply such information, when requested, will result in the termination of any further transactions between the vendor/bidder and the Town of Glastonbury.

COMPANY NAME AND ADDRESS: _____

TYPE OF BUSINESS: _____

TYPE OF ORGANIZATION: _____ Corporation _____ Partnership _____ Individual

If unit filing this application is not the above-named company, give the name, address and telephone number of reporting unit. (Branch, agent, representative)

AFFIRMATIVE ACTION/EQUAL EMPLOYMENT ACTIVITIES

Please indicate the name and address of the company official(s) responsible for carrying out the Equal Employment Opportunity/Affirmation Action Program for your company.

If your company does not have a written affirmation action plan, please estimate the number of vacancies during the next 12 months, and indicate the numerical or percentage goals you have set for the employment of minority people and females to make your labor force reflective of the labor market in which you operate.

The vendor/bidder understands that failure to complete the above form in satisfactory manner will preclude such vendor from being actively considered for contract with the Town of Glastonbury. The vendor/bidder also understands that the Affirmation Action statements will become part of any contract, and that breach of such statements will constitute a breach of the contract subject to such remedies as provide by law.

I certify that there are no misrepresentations, omissions, or falsifications in the foregoing statements and answers, and that the entries above are true, complete and correct to the best of my knowledge and belief.

_____ Date _____ Signature _____ Title

Subscribed and sworn to before me at _____, Connecticut, this _____ Day of _____ 20____.



SECTION 00810

NOTICE OF AWARD

Date of Issuance:

Owner: Owner's Contract No.:

Engineer: Engineer's Project No.:

Project: Contract Name:

Bidder:

Bidder's Address:

TO BIDDER:

You are notified that Owner has accepted your Bid dated [_____] for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

[describe Work, alternates, or sections of Work awarded]

The Contract Price of the awarded Contract is: \$ _____

[] unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award, or has been transmitted or made available to Bidder electronically. [revise if multiple copies accompany the Notice of Award]

a set of the Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver to Owner [____] counterparts of the Agreement, fully executed by Bidder.
2. Deliver with the executed Agreement(s) the Contract security [e.g., performance and payment bonds] and insurance documentation as specified in the Instructions to Bidders and General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any):

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner:

Authorized Signature

By:

Title:

Copy:

SECTION 00811

NOTICE TO PROCEED

Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer:	Engineer's Project No.:
Project:	Contract Name:
	Effective Date of Contract:

TO CONTRACTOR:

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on [_____, 20__]. [see Paragraph 4.01 of the General Conditions]

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work shall be done at the Site prior to such date. In accordance with the Agreement, the number of days to achieve Substantial Completion is _____, and the number of days to achieve readiness for final payment is _____].

Before starting any Work at the Site, Contractor must comply with the following:
[Note any access limitations, security procedures, or other restrictions]

Owner:

Authorized Signature

By:

Title:

Date Issued:

Copy:

SECTION 00836
CONTRACTOR'S AFFIDAVIT

STATE OF _____

COUNTY OF _____

Before me, the undersigned, a _____

(Notary Public, Justice of Peace, Alderman)

in and for said County and State personally appeared, _____

(Individual, Partner or duly

_____ who being duly sworn according to law

(Authorized Representative of Corporate Contractor)

deposes and says that the cost of all the Work, and outstanding claims and indebtedness of whatever nature arising out of the performance of the contract between

(Owner)

and _____ of _____

(Contractor)

dated _____ for the construction of the _____

(Agreement Date)

(Project)

_____ and necessary appurtenant installations have been paid in full.

(Individual, Partner, or duly authorized representative of corporate contractor)

Sworn to and subscribed before me

This _____ day of _____, 20____

END OF SECTION

SECTION 00837CONTRACTOR'S RELEASE

KNOW ALL MEN BY THESE PRESENTS that _____
 _____ (Contractor)
 of _____, County of _____ and State of _____
 do hereby acknowledge that _____ has this day had, and received of
 _____ (Contractor)
 and from _____ the sum of One Dollar and other valuable considerations in
 _____ (Owner)
 full and complete satisfaction and payment of all sums of money owed, payable and belonging to
 _____ by any means whatsoever, for on account of a Contract
 _____ (Contractor)
 Agreement between _____ and _____
 _____ (Owner) _____ (Contractor)
 dated _____ for _____
 _____ (Agreement Date) _____ (Project)

NOW, THEREFORE, the said _____
 _____ (Contractor)

(for myself, my heirs, executors and administrators) (for itself, its successors and assigns)
 do/does, by these presents remise, release, quit-claim and forever discharge _____
 _____ (Owner)
 , of and from all claims and demands, arising from or in connection
 with the said contract dated _____, and of and from all, and all manner of action
 _____ (Agreement Date)
 and actions, cause and causes of action and actions, suits, debts, dues, duties, sum and sums of
 money, accounts, reckonings, bonds, bills, specialties, covenants, contracts, agreements, promises,
 variances, damages, judgments, extents, executions, claims and demand, whatsoever in law or
 equity, or otherwise, against _____ its successors and assigns, which (I,
 _____ (Owner)
 my heirs, executors, or administrators) (it, its successors and assigns) ever had, now have or which
 (I, my heirs, executors, or administrators) (it, its successors and assigns) hereafter can, shall or
 may have, for, upon or by reason of any matter, cause, or thing whatsoever; from the beginning of
 recorded time to the date of these presents.

IN WITNESS WHEREOF, _____
(Contractor)

has caused these presents to be duly executed this _____ day of _____ 20_____

Signed, Sealed and Delivered in the presence of:

(Individual -Contractor) (seal)

(Partnership - Contractor) (seal)

By _____ (seal)
(Partner)

Attested:

(Corporation)

(Secretary) By _____
(President or Vice President)

(Corp. Seal)

END OF SECTION



SECTION 00838

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer:	Engineer's Project No.:
Project:	Contract Name:

This [preliminary] [final] Certificate of Substantial Completion applies to:

All Work The following specified portions of the Work:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work shall be as provided in the Contract, except as amended as follows: [Note: Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.]

Amendments to Owner's responsibilities: None
 As follows

Amendments to Contractor's responsibilities: None
 As follows:

The following documents are attached to and made a part of this Certificate: [punch list; others]

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract.

EXECUTED BY ENGINEER:		RECEIVED:	RECEIVED:
By: _____	By: _____	By: _____	
(Authorized signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)	
Title: _____	Title: _____	Title: _____	
Date: _____	Date: _____	Date: _____	

SECTION 00839

WAIVER OF LIEN - MATERIALS AND LABOR

STATE OF _____

COUNTY OF _____

To: _____ (Owner)

WHEREAS, _____ (the undersigned) have been employed by _____ (Contractor) on the _____ (Project Name) to furnish the following:

_____ (description of material and services).

NOW THEREFORE, the undersigned, for good and valuable considerations do hereby waive and release any and all lien, or right of lien, or claim to lien on said above project and premises under the Law, in relation to Mechanics' Liens Law, on account of labor and materials, or both, furnished by the undersigned to or on account of the said contract for the said project and premises only so far as that portion of work which has been included in our requisition dated _____ and all prior requisitions.

THIS WAIVER AND RELEASE is being made to the undersigned in the amount of \$ _____ which sum the undersigned certifies to be the balance due the undersigned for all labor, materials or both, furnished by the undersigned to or on account of the said contract as included on his requisition dated _____.

GIVEN UNDER our hand and seal, this _____ day of _____, 20 ____.

By: _____

Manufacturer, Supplier or Subcontractor Name

Signature of Authorized Representative

Printed Name and Title

END OF SECTION

SECTION 00841

WORK CHANGE DIRECTIVE

Work Change Directive No.

Date of Issuance:	Effective Date:
Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer:	Engineer's Project No.:
Project:	Contract Name:

Contractor is directed to proceed promptly with the following change(s):

Description:

Attachments: [List documents supporting change]

Purpose for Work Change Directive:

Directive to proceed promptly with the Work described herein, prior to agreeing to changes on Contract Price and Contract Time, is issued due to: [check one or both of the following]

- Non-agreement on pricing of proposed change.
- Necessity to proceed for schedule or other Project reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price	\$	[increase] [decrease].
Contract Time	days	[increase] [decrease].

Basis of estimated change in Contract Price:

- | | |
|---|-------------------------------------|
| <input type="checkbox"/> Lump Sum | <input type="checkbox"/> Unit Price |
| <input type="checkbox"/> Cost of the Work | <input type="checkbox"/> Other |

RECOMMENDED:

AUTHORIZED BY:

RECEIVED:

By:	By:	By:
Engineer (Authorized Signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Title:	Title:	Title:
Date:	Date:	Date:

Approved by Funding Agency (if applicable)

By: _____ Date: _____
Title: _____

SECTION 00842

CHANGE ORDER

Change Order No. _____

Date of Issuance: _____	Effective Date: _____
Owner: _____	Owner's Contract No.: _____
Contractor: _____	Contractor's Project No.: _____
Engineer: _____	Engineer's Project No.: _____
Project: _____	Contract Name: _____

The Contract is modified as follows upon execution of this Change Order:

Description: _____

Attachments: [List documents supporting change]

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIMES [note changes in Milestones if applicable]
Original Contract Price: \$ _____	Original Contract Times: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] from previously approved Change Orders No. ___ to No. ___: \$ _____	[Increase] [Decrease] from previously approved Change Orders No. ___ to No. ___: Substantial Completion: _____ Ready for Final Payment: _____ days
Contract Price prior to this Change Order: \$ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] of this Change Order: \$ _____	[Increase] [Decrease] of this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
Contract Price incorporating this Change Order: \$ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for Final Payment: _____ days or dates

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____ Engineer (if required)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title _____	Title _____
Date: _____	Date _____	Date _____

Approved by Funding Agency (if applicable)

By: _____ Date: _____
Title: _____

SECTION 01010SUMMARY OF WORKPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. Upgrading the Cider Mill Pump Station for the Town of Glastonbury. The major work proposed under this Contract includes, but it not limited to:
2. Construction of:
 - a. The upgraded pump station consists of: a new precast pump station wetwell and building, generator and appurtenances associated with electrical, mechanical, concrete, instrumentation, plumbing and process equipment as indicated on the drawings.
 - b. The installation of two (2) influent submersible sewage pumps, generator, piping, valves, fittings and appurtenances.
 - c. The installation of a new retaining wall.
 - d. Site work, dewatering, and landscaping. Including metal fence wood barrier installation.
 - e. The installation of a section of sewer force main, sewer gravity mains, and all associated appurtenances to the upgraded pump station.
 - f. Testing of all equipment systems for proper operation and performance.
 - g. Other miscellaneous work as specified and as indicated on the Drawings.
3. Partial and/or Complete Demolition (to the limits shown on the Drawings) of:
 - a. The existing generator enclosure, generator, concrete pad, and electrical appurtenances identified on the drawings.
 - b. All components of the existing pump chamber, including but not limited to: access chamber, access hatch, hardware, piping, equipment, access stairs and platform and all other associated appurtenances.
 - c. Existing underground propane tank and associated appurtenances.
 - d. Existing chain link fence, trees, bollards, and retaining wall.
 - e. Piping, conduit, structures, and instrumentation as indicated on the Drawings.
 - f. Other removals/demolitions as shown on the Drawings and specified herein including abatement of PCB containing materials.

B. Related Work Specified Elsewhere:

1. Construction Schedules: Section 01310.

C. Coordination:

1. See Section 01050 for information on contract coordination.

D. 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 general bid. This work shall include removals, relocations and rearrangements which may interfere with, disturb or complicate the performance of the work under the general 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 general 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. Existing Operations:

1. The Contractor shall be responsible for coordinating with the Owner when the pump station will need to be taken off-line. 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 price.
2. Utilities include, electric power and telephone.

B. Maintain Pump Station Operations:

1. State and federal regulations require that at all times during construction work under this contract, the pump station remain operational.
2. The responsibility of the Contractor shall be to provide, maintain and operate all temporary facilities such as dams, pumping equipment, conduits, and all other labor and equipment necessary to intercept the sewage, before it reaches the points where it would interfere with his work, and carry it past his work.
3. The Contractor's operations shall not hinder the delivery, storage and use of materials and supplies, nor hinder staff duties, nor disrupt utility service.
4. The Owner must have access to the existing pump station and equipment at all times unless a specific exception is granted by the Owner.

C. 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 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 on Cider Mill Road will disrupt the existing pump station structures and operations. To maintain flows, and to minimize disruption, the construction must be sequenced appropriately. The method utilized shall provide for back up pumping and/or generator systems as necessary until the new station is on-line.
- 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 shall include the cost of all temporary facilities required to bypass pump to maintain flows during the construction period in his bid price. The cost shall include the cost for all labor, tools, equipment and materials necessary.
- D. Pump Station daily flows to be maintained are as follows:
 - 1. Average Daily Flow 8,000 gpd
 - 2. Peak Hour Flow 40,000 gpd

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:
1. Provide a shop drawing submittal to include the following information:
 - a. Identification of coring and cutting subcontractor including: Company name, business address contact information, or if by Contractor indicated as such.
 - b. List of type of coring and cutting equipment proposed to be used with equipment cuts of the equipment.
 - c. Schedule indicating the: location of the core or cut, size and any potential obstructions or embedded conduits and wiring.
 - d. Key plan indicating the location of anticipated cores and cuts.
 2. Request for the Engineer's consent:
 - 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, so notify the Engineer and secure his 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 Division 3.

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 him. 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 his 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 Glastonbury:
 - 1. Contractor shall coordinate all work on Town property with Glastonbury Water Pollution Control Facility (WPCF) personnel.
 - 2. Contractor shall coordinate all activities that will interrupt wastewater flows with the Glastonbury WPCF.
 - 3. The Contractor shall be responsible for coordinating and maintaining general access and public services to all public and private properties.
 - 4. Contractor shall coordinate access, egress, detours and traffic control, if required, at the site with the Glastonbury Police Department. The Contractor shall notify Glastonbury Police, Fire Department and Rescue Squad at least 24 hours in advance of any street closings or detours.
- B. Eversource:
 - 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.
- C. Telephone:
 - 1. The Contractor shall be responsible for coordinating the telephone system with the telephone service company.
- D. Call Before You Dig (CBYD):
 - 1. The Contractor shall be responsible for coordinating and contacting Call Before You Dig prior to the commencement of work.
- E. The Contractor shall provide the Owner and Engineer 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 Resident Project Representative and Chief Operator concerning updating the schedule, job progress, delay or early starts that affect the treatment process, facility staffing, etc.

- F. The Contractor shall be responsible for explicitly notifying all equipment suppliers, electrical subcontractor, and the instrumentation supplier that they are required to coordinate their work with the instrumentation supplier by providing operating sequences, input/out specifications with wiring diagrams for all equipment, and that they shall review and comment on each other's shop drawings to insure that all interfaces are compatible.

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 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, 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 construction, if these actual quantities show either an increase or decrease from the quantities given in the Proposal Form, the Contract Unit Prices will still prevail.
- B. The Contractor shall accept in 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 payments shall be made subject to the provisions of the Supplemental and General Conditions.

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 Supplemental Conditions.
- B. No payment shall be made upon fuels, supplies, lumber, false work, or other materials, or on temporary structures of any kind which are not a permanent part of the Contract.

1.7 FINAL PAYMENT

- A. After final measurements are made by the Engineer, the Contractor will prepare 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 provisions of the General and Supplemental Conditions.

1.8 INCIDENTAL WORK

- A. Incidental work items for which separate payment will not be made includes, but is not limited to, the following items:
 1. Pre-Construction photographs.
 2. Project record documents.

3. Clean-up and restoration of property.
4. Cooperation and coordination with other Contractors and utility companies including related inspection costs and other costs (Refer to Section 01050).
5. Utility crossings and relocations, unless otherwise paid for.
6. Traffic Regulation
7. Temporary utility services to buildings, as required to maintain service during construction.
8. Minor Items--such as relocation of sign posts, mail boxes, curbs, pavement markings, etc., damaged as a result of construction activities.
9. Trench boxes, steel and/or wood sheeting as required, including that left in place.
10. Materials testing
11. Maintenance of all existing sewer flows and repair of existing sewer pipes.
12. Dewatering as necessary.
13. Dust control.
14. Erosion control.
15. Quality assurance testing.
16. Final cleaning of sewers, force mains and storm drains.
17. Clearing, grubbing and stripping.
18. Loam and seeding
19. Construction schedules, bonds, insurance, shop drawings, warranties, guarantees, certifications and other submittals required by the Contract Documents
20. Repair and replacement of water lines under 2-inches in size, culverts, underdrains, rock lined drainage trenches in streets and other utilities damaged by construction activities and corresponding proper disposal of removed materials.
21. Temporary construction necessary for construction sequencing and other facilities not permanently incorporated into the work.
22. Weather protection.
23. Permits not otherwise paid for or provided by the Owner.
24. Visits to the project site or elsewhere by personnel or agents of the Contractor, including manufacturer's representatives, as may be required.
25. Test pits to determine existing utility locations, soils conditions, and as required to complete the project.
26. Contract administration and insurance.
27. Test pits to establish in place field soils density, groundwater conditions, or requirements for dewatering.
28. On-site and other facilities acceptable to Engineer for the storage of materials, supplies and equipment to be incorporated into the Work
29. Pipe markings.
30. Pavement Markings
31. Removal of Existing Pavement
32. Earthwork
33. Maintenance of existing flows and bypass pumping
34. Replacement of unsuitable material above pipe bedding and backfill.

- 35. Mobilization/demobilization
- 36. Start-up services required by the Contract Documents

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.

Item 1. Cider Mill Pump Station

- A. Method of Measurement: Construction of the Cider Mill Pump Station shall be paid for at the Contract lump sum price stated in the Bid Schedule.
- B. Basis of Payment: Said lump sum price shall constitute full compensation for furnishing all labor, materials, tools and equipment necessary for upgrading the Cider Mill Pump Station, complete as indicated on the Drawings and as specified and all of its' appurtenances in its' entirety, except that work included for payment under other items. Provide bypass pumping as outlined in Specification 01515, as needed to complete the pump station upgrade. This item shall also include up to 10-CY of ledge removal.

Item 2. Electrical Utility Company and Telephone Service Allowance

- A. Method of Measurement and Payment: Cash Allowance.
- B. Basis of Payment: Owner will assist Contractor in establishing the fee with the electrical utility and telephone service companies. Refer to Section 16000 for a description of work to be performed by these utility companies. Adjustment to the final cost for this item will be made in accordance with the General Conditions.

Item 3. Landscaping and Plantings

- A. Method of Measurement: Lump Sum / Cash Allowance.
- B. Basis of Payment: Owner will assist Contractor in establishing the fee with for landscaping and plantings as selected by the Town. Adjustment to the final cost for this Item will be made in accordance with Paragraph 11.02 of the General Conditions.

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 his 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 he wishes.

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. To the maximum extent practicable, meetings will be held at the job site or at the Glastonbury Water Pollution Control Facility.

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 01310CONSTRUCTION SCHEDULESPART 1 - GENERAL1.1 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.
- D. Updating:
 - 1. Show all changes occurring since previous submission.
 - 2. Indicate progress of each activity, show completion dates.
 - 3. Include:
 - a. Major changes in scope.
 - b. Activities modified since previous updating.
 - c. Revised projections due to changes.
 - d. Other identifiable changes.

4. 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.

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 01320SAFETY AND HEALTH PLANPART 1 - GENERAL1.1 DESCRIPTIONA. 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, 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 issues, including but not limited to excavations, fall protection and egress, as well as provisions for construction in hazardous environmental conditions at the wastewater treatment facility. The hazardous environmental conditions at the wastewater treatment facility include, but are not limited to, confined space entry, electrically-classified spaces, and chemical storage and handling areas, to name a few.
2. Safety provisions for confined space entry shall follow General Industry Standard CFR Title 29 Part 1910.146 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. Spaces listed as Permit Required Confined Space may only be

- entered with a permit, alternate procedures (1910.146 (c) (5)), or reclassification to non-permit required confined space (1910.146 (c) (7)). 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.
 4. The Owner has provided Table 3 at the end of this section listing chemical storage and handling spaces 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 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. Contractor shall be responsible for all aspects of construction site safety. Provide 3 copies of the Contractor's site specific Safety and Health Plan to the Engineer. 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. The Contractor will overview the plan with the Owner (and staff), Engineer (and Resident Project Representative) at the beginning of the project, and subsequently when/if the safety plan is updated.
- B. Provide updated Safety and Health Plans as necessary during the course of the project.
- C. 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 SITE-SPECIFIC INFORMATION

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

**TABLE 1
CIDER MILL PUMP STATION
CONFINED SPACE LISTING**

Confined Space Location	Hazard Description
Influent Sewer Manhole, Existing Pump Chamber with Access Tube	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
CIDER MILL PUMP STATION
CLASSIFIED SPACES LISTING (NFPA 820)

Location	NFPA 820 Classification
Existing Pump Chamber with Access Tube	Class 1, Division 2
New Wetwell 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 01340SUBMITTALS1.1 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, his 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.
- 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, such as submitting miscellaneous metals grouped by structure, shall be requested in writing with an anticipated shop drawing breakdown/schedule prior to any associated submittal.

- 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 his 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 his subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to satisfy himself 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, he 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.

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.
- 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. O&M Manuals shall include operating and maintenance information on all systems and pieces of equipment. The manual shall contain sufficient data to install, operate, maintain, repair and rebuild all components of the equipment, design data specific to the project. Descriptions of operation should include procedures for both normal and emergency operation. All information required by the Operations and Maintenance Manual Certification Form described herein and any additional information deemed necessary by the Owner and Engineer for proper installation, operation and maintenance. Also include model numbers and serial numbers, as well as rated capacities and motor data, where applicable.
- D. 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.

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 decimal point and 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.

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. In Review (Status 5 on shop drawing log). The shop drawing is currently under review.
7. For Information Only (Status 6 on shop drawing log). The shop drawing review was for information only.

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^b

Manufacturer^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: _____

	- OM -	
O&M NUMBER:	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:

- | | |
|---|---|
| <input type="checkbox"/> Table of Contents | <input type="checkbox"/> Project-Related Design Data |
| <input type="checkbox"/> Maintenance Schedule and Summary | <input type="checkbox"/> Wiring Diagrams |
| <input type="checkbox"/> Lubrication Schedule | <input type="checkbox"/> Equipment Layout Drawings & |
| <input type="checkbox"/> Troubleshooting Information | <input type="checkbox"/> Equipment Performance Curves |
| <input type="checkbox"/> Warranty Information | <input type="checkbox"/> Parts and Service Contact Information |
| <input type="checkbox"/> Rebuild Information for All Components/
Systems | <input type="checkbox"/> Manufacturer's Contact Information |
| <input type="checkbox"/> Startup, Operation, Shutdown Procedures | <input type="checkbox"/> Emergency Operations Plan |
| <input type="checkbox"/> Safety Procedures | <input type="checkbox"/> List of Part Numbers for all
Components |
| <input type="checkbox"/> Shop Drawings corrected to As-Built
Conditions | <input type="checkbox"/> List of Spare Parts Supplied and Cost |
| | <input type="checkbox"/> 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.

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General Contractor's Stamp

PROCESS EQUIPMENT MANUFACTURER SUBMITTAL CERTIFICATION
(Divisions 11 and 14)

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 01370SCHEDULE OF VALUESPART 1 - GENERAL1.1 DESCRIPTION

A. Extent of Work:

1. Provide a detailed breakdown of the agreed 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. The breakdown shall divide the projects into its appropriate component parts together with a quantity and a unit price for each part such that the sum of the products of quantities and unit prices will equal the contract price for the item(s). Coordinate with the Engineer regarding the level of detailed warranted for the project.

B. Related Work Specified Elsewhere:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections of these Specifications.
2. Schedule of values is required under the General Conditions.
3. Schedule of values is required to be compatible with applications for progress payment.

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. Prior to first application for payment, submit a proposed schedule of values to the Engineer.

1. Secure the Engineer's approval of the schedule of values prior to submitting first application for payment.

END OF SECTION

SECTION 01380PRE-CONSTRUCTION PHOTOGRAPHSPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. Pre-Construction Record: Contractor shall utilize digital photographs and video to obtain a visual record of the project area; copies of same shall be given to the Engineer and Owner.
2. Notify Engineer at least three (3) working days prior to photographing or videoing the project area so Engineer may, at his option, observe.

1.2 QUALITY

- A. Pre-Construction Record: Quality shall be such that the condition of existing pavement, curbing, driveway entrances, sidewalks, etc. can be readily determined.

1.3 1.3 SUBMITTAL OF PRINTS

- A. Pre-Construction Record: Submit electronic files on flash drive, and video electronic files on DVD to the Engineer and Owner prior to any construction work.
- B. The quality of the photos and video are subject to approval by the Engineer prior to the start of construction work in the areas shown by the photos.

END OF SECTION

SECTION 01400
QUALITY CONTROL

PART 1 - GENERAL

1.1 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 00700 - General Conditions: Inspection and testing required by governing authorities.
- B. Section 01340 - Submittals: Submittal of Manufacturer's Instructions.
- C. Section 02200 - Earthwork.
- D. Section 03300 - Cast-in-Place Concrete.

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 mailed within 5 days of obtaining test results. If test results indicate deficiencies, Independent Testing Laboratory shall telephone or FAX 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 coordinate all testing work and shall notify Engineer and Independent Testing Laboratory at least 24 hours prior to performing work requiring testing services. 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.

PART 2 - PRODUCTS
Not Used

PART 3 - EXECUTION
Not Used

END OF SECTION

SECTION 01500TEMPORARY FACILITIES AND CONTROLSPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. Provide and pay for all temporary applicable 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.
 - c. 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.
 8. 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.
 9. 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. 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 woodwork, 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. There is no city water service available in the area.
 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 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.
 4. Relocate temporary toilet facilities as required to facilitate the construction.
 5. 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.
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. 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 electrical facilities.
- B. **The Contractor may utilize an onsite manhole to draw sewage from. The pump on elevation must be below the incoming sewer main and incoming service connection for #255 Cider Mill Road. In addition, a temporary backwater valve or other means shall be installed on the service connection to prevent any sewage back-ups in to the home. The bypassed flow will be discharged to a contractor installed temporary connection to the existing 4-inch force main to be constructed as part of this project. The existing force main is approximately 1,000-feet long and discharges at elevation 470.5-feet.**
- C. 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.
- D. 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 Contractor 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.

Cider Mill Pump Station

	FLOW
CONDITION	GPD
Average	<i>8,000</i>
Peak	<i>40,000</i>

2. The pumps will be required to pump from an onsite sewer manhole to a new bypass pumping connection to be constructed as part of this project. The total required length of temporary forcemain will be approximately 50-feet not including any pipe required to manifold multiple pumps together, etc.
3. **The bypass pumping system shall include a variable speed electrically driven lead pump with diesel driven back-up pump(s). The lead pump shall convey no less than 200-gpm at full speed or shall be locked out at a preset speed to prevent damaging the force main. All pumps shall be critically silenced to less than 68 decibels at 25 feet.**
4. 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.
5. 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 to 28 vertical feet, at sea level.
6. 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. 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 temporary Bypass Pumping Connection shall be by Class 53 Ductile Iron piping, as shown on the Drawings. Hoses will also be allowed pending approval.
 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 operate and maintain the system until the new electrical upgrade facilities and completed, demonstration tested and accepted by the Owner and Engineer.
 5. 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 01546USE OF EXPLOSIVESPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included:
 - 1. Drilling, blasting, and removal of all ledge within the limits of excavation as indicated on the Contract Drawings.
 - 2. Pre-blast and post-blast surveys of existing structures and utilities.
 - 3. Seismic monitoring and documentation of all blasting.
- B. Related Work Specified Elsewhere (When Applicable):
 - 1. Section 02200 Earthwork
 - 2. Section 02156 Temporary Excavation Support System
 - 3. Section 02401 Temporary Dewatering System
 - 4. Geotechnical Data Report is provided in Appendix __.

1.2 REFERENCES

- A. NFPA 495 (2010) - Explosive Material Code
- B. US Department of Interior Bureau of Mines – Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting (RI 8507)
- C. Occupational Safety and Health Administration (OSHA) 29 CFR 1910.109 Explosives and Blasting Agents
- D. State Blasting Regulations
- E. Local Blasting Regulations

1.3 QUALITY ASSURANCE

- A. Perform all blasting operations, including, but not limited to transportation, storage, handling, use and disposal, in accordance with all applicable Local, State and Federal laws, ordinances and code requirements, including NFPA 495 and 29 CFR 1910.109, unless otherwise specified herein.
- B. All blasting operations shall be performed by a single firm.
- C. Qualifications:
 - 1. Blasting Subcontractor:
 - a. Shall possess a current blasting license issued by the appropriate regulatory authority within the project state.
 - b. Shall have a minimum 5-years' experience on similar blasting projects.
 - 2. Seismic Monitoring Subcontractor:
 - a. Shall be experienced in the use of seismographs and interpreting the information recorded.
 - b. Shall have a minimum 5 years' experience on similar blasting projects.
 - c. shall be selected and employed by the General Contractor.
 - d. may be the Blasting Subcontractor, upon approval of the Engineer.
 - 3. Pre-Blast and Post-Blast Survey Subcontractor:

- a. Shall be experienced in conducting pre-blast and post-blast surveys and documenting existing conditions of structures, buildings, utilities and monuments.
 - b. Shall have a minimum 5 years' experience on similar projects.
 - c. Shall be selected and employed by the General Contractor.
- D. The Blasting Subcontractor shall secure and pay for all necessary blasting permits, and furnish proof of permitting by all Local and State departments having jurisdiction.
- E. A Pre-Blast Meeting shall be conducted, at the discretion of the Owner and Engineer, by the Blasting Subcontractor to discuss blasting procedures prior to the commencement of blasting operations. The meeting shall be attended by the Engineer, Owner, Blasting Subcontractor, Seismic Monitoring Subcontractor, pre-blast and post-blast Survey Subcontractor, and local utility companies (_____).

SUBMITTALS

- A. Submit qualifications of the Blasting Subcontractor, Seismic Monitoring Subcontractor and Pre-Blast/Post-Blast Subcontractor, including the names and qualifications of the individuals who will be directly responsible for the work.
- B. Blasting Subcontractor – proof of liability insurance and permitting shall be submitted prior to mobilization of blasting materials.
- C. Submit blasting plan prior to the commencement of the blasting operations. The blasting plan shall include the following:
 - 1. All equipment that will be used in the blasting operations.
 - 2. Methods of matting or covering the blast area in open excavations to prevent flyrock and excessive air overpressure (airblast), and dust and fume mitigation.
 - 3. Diameter, spacing, depth and bottom of blast hole elevation. Amount of explosive used per hole, on each delay and the total for the blast.
 - 4. Calculations of ground vibration at adjacent structures and/or monitoring locations based on the proposed blasting plan and distances to adjacent structures and/or monitoring locations.
 - 5. Name and qualifications of individual responsible for the design of the blasting program.
 - 6. Description of audible warning system to be used.
- D. Submit a monitoring plan prepared by the Seismic Monitoring Subcontractor with the coordination of the Blasting Subcontractor. The monitoring plan shall include the following:
 - 1. Specifications of proposed instruments used to monitor ground vibrations and air overpressure. Submit calibration documents from within the past year.
 - 2. Plan indicating Blasting and Seismic Monitoring locations relative to existing buildings and/or other structures.
- E. Submit copy of blasting permits prior to beginning blasting operations.
- F. Submit pre-blast survey documentation/report.
- G. Submit post-blast survey documentation/report.
- H. All shop drawings shall submitted for information only.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Explosive charges and detonation devices shall be of a type suitable for the intended

use. The use of blasting materials shall meet the manufacturer's specifications and safety requirements.

PART 3 - EXECUTION

3.1 PRE-BLAST SURVEY

- A. Prior to commencing blasting operations and prior to installing excavation support systems, a pre-blast survey shall be conducted, and may be attended by the General Contractor, Blasting Subcontractor, and Engineer.
- B. The structures to be surveyed shall be within [250 / 500] feet in all directions from the edge of each blasting locale as shown on the seismic monitoring plan. Structures to be surveyed, and their distance from the blast site may be influenced by the blast design, predicted vibration level and site specific public relations requirements.
- C. The pre-blast survey shall include color photographs and/or high definition videos of all structures, buildings (including items such as bridges, dams, etc.) and water supply wells within the pre-blast survey zone. The photos and videos shall include both the exterior of each building and structure and all accessible interior rooms of each building, at the discretion of the property owner. All photos shall have the date permanently imprinted on the image.
- D. Prior to blasting, all wells shall be documented and tested as follows:
 - 1. Flow test to measure the yield.
 - 2. Water quality tests by a State certified laboratory for bacteria and turbidity.
- E. The Owner will coordinate access for survey work on adjacent properties.
- F. The Pre-Blast Survey Subcontractor shall submit a final report, which shall include the following:
 - 1. Dated photographs with written identification of each, and/or high definition video of all buildings and other structures surveyed.
 - 2. A written report shall be submitted a minimum of one week prior to commencement of blasting operations or excavation support system installation. The report will be made available to property owners on an as needed basis, with the cost borne by the Owner. The report shall include the following for each building, other structure, and wells:
 - a. Location and description.
 - b. Description of the overall condition.
 - c. Noted physical deficiencies, cracks, pertinent elevations and other physical conditions that could be potentially affected by blasting operations.
 - d. Yield and water quality test results of each water supply well.

3.2 PERFORMANCE - GENERAL

- A. Drilling and blasting materials and methods shall be those necessary to accomplish ledge excavation required for completion of the work indicated on the Contract Drawings.
- B. Blasting shall not commence until the pre-blast survey has been completed and submitted.
- C. All explosives shall be stored and handled in a secure manner, in compliance with all Local, State and Federal laws, ordinances, and code requirements. Storage locations

shall be legibly marked (vehicles placarded), and daily-use quantities limited to such quantities as may be needed for the current workday, including those necessary for changing site conditions. Explosives shall not be stored on site during non-working hours.

- D. All blasting shall be performed in accordance with all Local, State and Federal laws, ordinances and code requirements.
- E. All blasting areas shall be properly identified with appropriate signs or identification markers as required by law. Blasting signs notifying those approaching the blast site shall be placed at each entrance to the site or blasting area. Blasting notification signs shall be left in place while the above conditions prevail. Immediately remove signs after blasting operations have been completed.
- F. All blasting shall be conducted within the hours of a.m. – p.m. from Monday through Friday. Any and all blasting outside of these time limits shall be subject to approval from the Owner, and shall be in compliance with all Local, State and Federal laws, ordinances and code requirements.
- G. All safety precautions shall be taken to protect individuals in the direct vicinity of the blasting operations. Blasting mats or other means to prevent flying rock shall be utilized.
- H. Conduct blasting operations such that damage is prevented to adjacent buildings, other structures, water supply wells, public domain, natural resources and habitat. Acceptable peak particle velocity limits and peak air overpressure limits shall not be exceeded.
- I. General Contractor shall notify each property owner and public utility company with buildings or other structures within a minimum 500-foot radius of the site work at least 10 days prior to initiating pre-blast surveys to enable the owners to take such steps as they may deem necessary to protect their property. The actual blasting program to be implemented may require notification beyond the 500-foot radius. Notice shall be published in a local paper no more than 30 days and no less than 10 days prior to the initiation of the blasting. .
- J. General Contractor shall notify the Engineer at least 72 hours prior to commencing blasting operations.
- K. An audible warning system shall be employed to warn all persons on site of blasting operations. Do not perform blasting work until the area is cleared and secure. Take appropriate precautions to prevent individuals from entering the blasting area. Provide sufficient flagmen outside the danger zone to stop all approaching traffic and pedestrians. The audible system shall include a warning that blasting is to commence, and notification that blasting is complete. Signs explaining the audible warning system shall be posted prior to blasting.
- L. When blasting in areas where rock removal is required adjacent to and below existing structures, care shall be taken at the excavation limits to minimize over-blasting (back break or side break) and fracturing of remaining rock. Hydraulic hammer line drilling, presplit, or other means may be required to minimize the impact to the remaining rock relative to the site-specific conditions and geologic structure.
- M. Perform at least one controlled test blast prior to commencement of production blasting in order to substantiate, or if necessary adjust, the proposed blast design to ensure vibration and overpressure limits are not exceeded. Coordinate scheduling of

test blast/s with Engineer.

3.3 VIBRATION CONTROL

- A. All blasting operations shall be conducted to limit ground vibrations to acceptable limits to help ensure that adjacent structures and buildings are not damaged.
- B. Acceptable ground vibration limits shall be:
 - 1. Based on peak particle velocity and peak displacement are presented in US Bureau of Mines (USBM) RI 8507, Appendix B.
 - 2. The following vibration limits (Peak Particle Velocity in inch/sec) shall be adhered to based upon the USBM Alternative Blasting Level Criteria (adopted from RI 8507, 1980) relative to vibration frequency of blasts:
 - a. Greater than 40 Hz - Maximum PPV = 2.0 in/s
 - b. Greater than 30 Hz but not more than 40 Hz - Maximum PPV = 1.5 in/s
 - c. Greater than 20 Hz but not more than 30 Hz - Maximum PPV = 1.0 in/s
 - d. Not more than 20 Hz - Maximum PPV = 0.5 in/s
- C. The peak air overpressures measured at the nearest above grade occupied structure shall not exceed 133 dB (0.014 psi).
- D. Blasting shall not be permitted less than 72 hours after completion of any and all concrete placements within 250 feet. Blasting shall not be permitted less within 100 feet of freshly placed concrete until such concrete has cured for a minimum of 72 hours and has attained 33% of its 28-day design strength.
- E. Adherence to the above listed limits shall not relieve the Contractor of the responsibility to protect existing structures.
- F. If these values are exceeded, Contractor shall stop blasting and submit a revised blasting plan. The revised blasting plan shall indicate why the limits were exceeded and indicate what changes will be made to prevent future exceedances.

3.4 BLASTING DOCUMENTATION (BLAST LOGS)

- A. The Blasting Subcontractor shall prepare and maintain copies of all blasting logs which shall include, but not be limited to, the following information:
 - 1. Date, time and location of blast.
 - 2. Diagram of blast pattern showing the number, diameter, depth, subdrill, distribution, and powder factor for the explosives used per hole and per blast.
 - 3. Sequence and schedule of blasting rounds and delay pattern.
 - 4. Blast evaluations.
 - 5. Weather and temperature conditions.
- B. For each blast at all blast sites, the Seismic Monitoring Subcontractor shall monitor the blasting vibrations and overpressures at a minimum of two buildings or other structures within [250 / 500] feet of each blast. This may be adjusted dependent upon the blast design and site-specific conditions as deemed necessary. One monitoring location shall be the nearest structure. Monitoring locations shall preferably be in different directions from the blast. The buildings or other structures to be monitored shall be mutually agreed upon by the Engineer, General Contractor, and Blasting Subcontractor. Blast monitoring shall commence just before the blasts are set off. Record vibration and overpressure measurements, which shall include, but not be limited to:
 - 1. Identification of monitoring instrument, and serial number.

2. Calibration certificate dated within the past year.
 3. Name of instrument operator.
 4. Building or other structure at which the monitoring instrument is located, and distance from such structure.
 5. Distance and direction of monitoring instrument from blast site.
 6. Date and time of reading.
 7. Type of ground at recording station.
 8. Peak particle velocity and frequency for all components (vertical, radial and perpendicular).
 9. Values of air overpressure.
 10. Printed copies of measurement readings.
 11. Blast vibration and air overpressure measurement records shall be made available to Owner and Engineer on a weekly basis as deemed necessary, or as requested.
- C. Crack Monitors:
1. Where required, crack monitors shall be installed by the Seismic Monitoring Subcontractor. They may be required on structures that are within the zone of displacement or heave of the blast (within 20 feet), and/or at cracks in concrete and/or masonry that are greater than 1/16 inches (1.6 mm) wide and within 250 feet of the blast area. Crack monitor locations shall be as determined by the Engineer, Contractor, Blasting Subcontractor, or Seismic Monitoring Subcontractor. All crack monitors shall be documented on plans of the buildings or structures with reference numbers for each monitor.
 2. All cracks shall be measured and documented prior to commencement of blasting. Crack widths shall be measured to the nearest 0.10 millimeters.
 3. Crack monitors shall be installed at the following locations:
 - a. Xx
 - b. Xx
 - c. Xx
- D. Video Recording of Blasts:
1. Contractor shall digitally record each blast from two locations approximately perpendicular to one another. The recordings shall be named to identify the blast. Contractor shall maintain a library of all video recordings.

3.5 POST-BLAST SURVEY

- A. After conclusion of all blasting work, a post-blast survey shall be conducted at all buildings, structures and water supply wells that were part of the pre-blast survey. The survey may be attended by the General Contractor, Blasting Subcontractor, Engineer, and Owner. A report comparing the pre and post-blast conditions shall be provided.

3.6 DAMAGE TO STRUCTURES AND BUILDINGS

- A. The General Contractor shall be responsible for all damages caused by blasting operations regardless of the adherence to specified vibration limits.
- B. Such damage shall be repaired by the General Contractor at no additional cost to the Owner. The General Contractor shall submit proposed repairs, which shall be reviewed by the Engineer with no exceptions taken. Damages shall be defined as:

1. Physical damage to the structure or building.
 2. Newly formed cracks in concrete or masonry.
 3. Substantial increase in width and/or length of existing cracks in concrete or masonry.
 4. Structure or building movement.
 5. Reduction in water supply well yield or water quality.
- C. The extent of damages caused by blasting operations shall be determined by the Engineer. The Engineer will notify the General Contractor in writing of all damages caused by blasting operations. Disputes shall be resolved based on review of the pre-blast and post-blast surveys, seismic readings, etc.

END OF SECTION

SECTION 01546

USE OF EXPLOSIVES

SECTION 01562DUST CONTROLPART 1 - GENERAL1.1 DESCRIPTIONS

A. Work Included:

1. Furnish and apply water or calcium chloride on the road surfaces within the construction site, when required to control dust and when directed by the Engineer.
2. When dust control is not included as a separate item in the Contract, the work shall be considered incidental to the appropriate items of the Contract.

PART 2 - PRODUCTS2.1 MATERIALS

A. Water for Sprinkling:

B. Clean, free of salt, oil, and other injurious matter.

C. Calcium Chloride:

1. Meet the requirements of AASHTO M144.

PART 3 - EXECUTION3.1 APPLICATION

A. Water:

1. Apply water by methods approved by the Engineer.
2. Use approved equipment including a tank with gauge equipped pump and spray bar.

B. Calcium Chloride:

1. Apply at a rate sufficient to maintain a damp surface but low enough to assure non-contamination of water courses.
2. Apply water prior to calcium chloride addition.

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 workmen, 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).
2. 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.

B. Related Work Specified Elsewhere:

1. Shop Drawings, Project Data, and Samples are specified in "General Conditions" and Section 01340, Submittals.

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 this 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.

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 ties should be taken from existing, permanent features such as utility poles, corners of buildings and hydrants. Porches, sheds or other house additions

should be avoided as they could be torn down. A minimum of two ties should be taken.

2. Stations should be recorded to the nearest foot.
 3. Inverts should be recorded to the nearest hundredth of a foot.
 4. Elevations should be recorded to the nearest hundredth of a foot.
 5. Building dimensions should be recorded to the nearest 1/4".
 6. Equipment and Piping should 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 should be shown on plan. Utility should be drawn to scale in section (horizontally and vertically) and an elevation should be called out to the nearest hundredth of a foot.
 - c. When existing utility lines are broken and repaired, ties should be taken to these locations.
 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 should be recorded.
 - b. Revise elevations indicated on the Drawings to reflect actual construction.
5. House Services
 - a. Draw all house services (even to empty lots) on plan, and show ties.
 - b. Show ties or distances to wyes from manhole.
 - c. Show chimneys heights in the profile.
 - d. The Wright-Pierce "Sanitary Sewer Service Location" forms shall be used to record sewer service information. A copy of these forms should be provided to the Owner, along with the Record Drawing Set.
6. Ledge
 - a. Ledge profiles should be shown. Note whether the plotted ledge profile reflects undisturbed or expanded conditions.
7. Yard Piping and Buried Electrical Conduit
 - a. Site piping should 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.
8. 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.
9. Buildings
 - a. In general, small changes to structures should not be redrawn. If any dimensional changes were made in the field, the numerical change should 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 should 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 should 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 should 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.
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 should 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 should 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 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.
- 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 his authorized representative.

- C. Failure to supply all information on the Project Record Drawings as specified in Part 1.3 may result in additional retainage from monthly partial payment requests, and in non-approval of final payments of the Contract and/or if contract time (as specified in accordance with the Standard General Conditions of the Construction Contract) has elapsed, this shall be grounds for the enactment of the liquidated damages as specified.

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. Failure to maintain current records, as specified herein, shall be grounds for withholding additional retainage from monthly partial payment requests.
- D. Failure to provide records shall be grounds for withholding of final payment and, if beyond contract time, shall be grounds for imposing liquidated damages.

END OF SECTION

SECTION 01800EQUIPMENT STARTUP, CERTIFICATION AND OPERATOR TRAININGPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. General: The work included in this Section includes startup of equipment, Certified Equipment Testing and Manufacturer provided Operator Training of the facility personnel in the proper operations and maintenance of the furnished equipment. This shall include all equipment provided for the project, regardless of specification Division, unless specifically noted otherwise. Clean, test and adjust each piece of equipment and/or system to the complete satisfaction of the Engineer.
2. One Year Service Call: In addition to the Manufacturer's installation and startup/testing services, the Contractor shall arrange for the Manufacturer to provide one additional service call of one 8 hour working day on site upon demand of the Owner for each type of equipment within the first year of operation (commencing upon date of Substantial Completion) at no additional cost to the Owner. The one year service call on the generator shall include a full maintenance check and the changing of all fluids and filters.

B. General Definitions:

1. Equipment Startup shall be generally defined as the initial placing into operation of the equipment by representatives of the Contractor, any subcontractors directly responsible for the equipment provided, and the equipment Manufacturer.
2. Certified Equipment Testing shall generally be defined as the formal and scheduled demonstration of operations in accordance with the requirements of the Contract Documents. 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 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 systems are specified in Division 13.
3. Hoisting equipment is specified in Division 14.

EQUIPMENT STARTUP, CERTIFICATION AND OPERATOR TRAINING

4. Plumbing and HVAC Systems are specified in Division 15.
 5. Electrical systems are specified in Division 16.
- D. Submittals:
1. A minimum of ten days prior to the Pre-Startup Meeting, Contractor shall provide a preliminary equipment start-up schedule and plan for the Certified Equipment Testing and the Operator Training for each piece of equipment to the Engineer for review. The Manufacturer(s) shall provide the Contractor with a start-up schedule and plan. This preliminary plan will include a written outline description of the means and methods to be employed during the certified equipment test of each piece of equipment. The schedule and means and methods of testing will be discussed with the Engineer at the pre-startup meeting for acceptance.
 2. Submit the name(s) and resume(s) of the duly authorized representatives of the Manufacturer proposed for the project at least 30 days prior to the need for such services. The qualifications of duly authorized representatives of the Manufacturer are identified in Paragraph 1.2 below.
- E. Schedules:
1. The pre-startup meeting shall be held at least ten working days prior to the startup of the first piece of equipment supplied under the Contract. The meeting shall be held at the Project Site. Manufacturer(s) may attend in person or via telephone/video conference. At that time, the Contractor shall present his plan as detailed in the previous Part D "Submittals" and review Engineer's comments and concerns associated with the general features of each piece of equipment which must be demonstrated.
 2. Contractor shall provide Engineer with at least 72-hours' notice of his desire to perform Certified Equipment Testing and/or training to allow necessary coordination with Owner representatives. Contractor shall be responsible for any and all coordination necessary with the daily operations of the facility to accommodate his testing schedule. 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.
 3. Operator Training may be conducted concurrently with the Certified Equipment Testing with prior approval of the Engineer. However, 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. Under such conditions, and as deemed necessary by the Engineer, Operator Training will be conducted separately from, and subsequent to, the Certified Equipment Testing.

1.2 QUALITY ASSURANCE

- A. Duly authorized representative of the Manufacturer 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 USED)

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. Refer to Paragraph 1.1.D above.
- B. The Equipment Startup shall be performed prior to Certified Equipment Testing and prior to Operator Training.
- 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 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, automatic and safety control features of the equipment functions properly, including all alarm, activation and deactivation sequences.
 3. Verify that the equipment can operate without excessive noise, vibration, overheating, overloading, jamming, etc. during normal operating conditions.
 4. Check amperage draws on all power feeds with equipment running under normal operating conditions.
- 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 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 CERTIFIED EQUIPMENT TESTING

- A. Certified Equipment Testing shall be performed after the equipment startup testing is completed and it has been verified that equipment functions in accordance with the requirements of the Contract Documents in all aspects. Certified Equipment Testing shall be performed by the authorized representative(s) of the Manufacturer as identified in the Submittals. Refer to Paragraph 1.1.D above.
- B. Certified Equipment Testing shall not be scheduled concurrently with the equipment startup without the prior approval of the Engineer. In all cases, if the Engineer has arrived on-site for the scheduled Certified Equipment 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 startup demonstrations to verify the requirements of the Certified Equipment Testing is stressed.
- C. At a minimum during the Certified Equipment Testing, the Contractor shall demonstrate to the complete satisfaction of the Engineer the following:
 1. 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. That all manual, automatic and safety control features of the equipment functions properly, including all alarm, activation and deactivation sequences.
 3. That the equipment can operate without excessive noise, vibration, overheating, overloading, jamming, etc. during normal operating conditions.
 4. Amperage draws on all power feeds with equipment running under normal operating conditions.
 5. 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.
 - i. Each unit shall be monitored for compliance independently with other area equipment deactivated.
 - ii. For monitoring, the equipment will be run under normal operation conditions.
 - iii. Contractor shall provide certified proof of calibration for instrument utilized to measure noise level.
 6. Other specific requirements as outlined within the individual specifications sections.
- D. Each piece of equipment shall be tested sufficiently to ensure that all features required to be demonstrated and/or verified are within acceptable limits.

EQUIPMENT STARTUP, CERTIFICATION AND OPERATOR TRAINING

- E. 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.
- F. 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.
- G. The Contractor shall provide all power, chemical, equipment, labor, water and fuel as required for startup and testing.
- H. 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 his responsibilities to demonstrate proper operation or verify specific requirements for each individual component.
- I. Minimum Certified Equipment Testing Requirements for Pumps:
 - 1. If sufficient sewage or water is not available for tests, Contractor will provide water at his expense for testing, if so directed.
 - 2. During tests, observe and record head, output, rpm and motor input. 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. Refer to Section 11000, 11310 and 15400, as applicable, for additional details.
- J. Minimum Certified Equipment 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 and demonstrated after the system is placed in service.
 - 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 Section 13440 and Section 15604, as applicable, for additional details.
- K. Minimum Certified Equipment Testing Requirements for Electrical Systems.
 1. Refer to Section 16620 and 16950.
- L. In the event of an unsuccessful Certified Equipment Test, Manufacturer and Contractor shall make necessary alternations, adjustments, repairs and replacements and the equipment testing shall be repeated.
- M. The Manufacturer Representative's shall fill out the Equipment/System Testing Certification form included at the end of this Section. Certification 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. Refer to Paragraph 1.1.D above.
- 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. At the Owner's discretion, the training sessions may be video recorded for Owner's future use.
- E. Refer to individual equipment specification sections for further requirements.

EQUIPMENT START-UP CERTIFICATION

EQUIPMENT STARTUP, CERTIFICATION AND OPERATOR TRAINING

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 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.

(Authorized Representative of the Manufacturer) (Date)

(Contractor) (Date)

(Engineer) Wright-Pierce (Date)

** Attach Manufacturer Representative's Field Report **

EQUIPMENT TRAINING CERTIFICATION

Owner: _____

Date: _____

Project: _____

Contractor: _____

Equipment Manufacturer: _____

Equipment: _____

1. I have trained the Owner's personnel in the proper operation and maintenance of the above equipment.

(Authorized Representative of the Manufacturer) (Date)

2. The personnel listed below attended the training session.

(Owner's Representative) (Date)

3. Witnessed by: _____
Wright-Pierce (Date)

Wright-Pierce
99 Main Street
Topsham, ME 04086

CERTIFIED EQUIPMENT/SYSTEM TESTING FORM

Owner: _____

Date: _____

Project:

Contractor:

Equipment Manufacturer:

Equipment:

This certifies that the entire equipment/system has met the requirements of Section 01800, 16950 and all other applicable requirements of the contract documents.

(Authorized Representative of the Manufacturer

(Date)

(Contractor)

(Date)

(Engineer) Wright-Pierce

(Date)

** Attach Manufacturer Representative's Field Report **

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. 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. The Town will provide a local disposal site at no cost the contractor for bituminous concrete, concrete, clean fill, non-hazardous metals. Acceptability of materials for disposal shall be coordinated and authorized with/by the Superintendent of Sanitation.
3. Demolition and alteration work within occupied areas shall be accomplished with minimum interference to the occupants and to the pump station which shall be in continuous operation during construction.
4. 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.
5. 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.
6. 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.

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. Maintain Flows:
1. During demolition, maintain system flows as outlined in Section 01010, Summary of Work.
- J. Demolition Sequence:
1. The demolition sequence is to conform the reviewed and approved project schedule, and restrictions outlined in Section 01310, Construction Schedules.

END OF SECTION

SECTION 02110CLEARING AND GRUBBINGPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. Clearing includes, but is not limited to, removal of trees, brush, stumps, wooded growth, grass, shrubs, poles, posts, signs, fences, culverts and other vegetation and minor structures; the protection of designated wooded growth; the storage and protection of minor structures and materials which are to be replaced; and the disposal of nonsalvageable structures and materials, and necessary preliminary grading.

B. Limits of Work:

1. Perform clearing and grubbing work within the areas required for construction, or as shown on the Drawings, to a depth of 12 inches below the existing grade.
2. Perform additional clearing and grubbing work within areas and to depths which, in the opinion of the Engineer, interfere with excavation and/or construction, or are otherwise objectionable.

C. Work Not Included:

1. Clearing and grubbing work performed for the convenience of the Contractor will not be considered for payment.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Dispose of combustible material by burning only when permitted by and in accordance with all applicable local and state laws, ordinances and code requirements.

B. Remove and dispose of nonsalvageable structures and material in accordance with all applicable local and state laws, ordinances and code requirements.

PART 2 - PRODUCTS2.1 MATERIALS

A. Provide all materials required to complete the work.

B. All timber and wood shall become the property of the Contractor unless other agreements are made between the Owner and the Contractor.

C. Repair any damage to structures to the complete satisfaction of the Owner and Engineer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Carefully preserve and protect from injury all trees and/or shrubs not to be removed.
- B. Right-of-way:
 - 1. Where excavation is required on public or private rights-of-way containing trees, shrubs, other growth, or any structure or construction, obtain the Engineer's direction concerning the extent to which such obstacles can be cleared or stripped prior to performing the Work.
 - 2. In all rights-of-way, remove only those particular growths or structures which are, in the opinion of the Engineer, essential for construction operations.
 - 3. All other removals or damage shall be replaced or restored at the Contractor's expense.

3.2 PERFORMANCE

- A. Clearing:
 - 1. Remove and dispose of all trees, brush, slash, stubs, bushes, shrubs, plants, debris and obstructions within the area to be cleared, except any areas that may be designated as "Selective Clearing", and except as otherwise shown on the Drawings or as directed by the Engineer.
 - 2. Remove all stumps unless otherwise directed by the Engineer.
 - 3. Dispose of material to be removed daily as it accumulates.
 - 4. Take special care to completely dispose of all elm trees and branches immediately after cutting either by burial in approved locations or, when permitted, by burning in areas well removed from standing elm growth.
- B. Protection of Wooded Growth:
 - 1. Fell trees toward the center of the area being cleared to protect trees and shrubs to be left standing.
 - 2. Cut up, remove and dispose of trees unavoidably falling outside the area to be cleared.
 - 3. Employ skilled workmen or tree surgeons to trim and repair all trees that are damaged but are to be left standing.
- C. Selective Clearing:
 - 1. When shown on the Drawings and when directed by the Engineer, perform selective clearing work to preserve natural tree cover.
 - 2. Perform selective clearing work only under the direction and supervision of the Engineer.
 - 3. Remove all dead and uprooted trees, brush, roots and other material which, in the opinion of the Engineer, are objectionable.
 - 4. Cut flush with the ground and remove only those trees indicated by the Engineer.
 - 5. Employ skilled workmen or tree surgeons to carefully trim all branches requiring cutting on trees to be left standing. Wood exposed as the result of removal of branches is to be left exposed to air and sunlight.
 - 6. Bituminous paint shall not be used on wood exposed as a result of branch removal, excavation around roots, or damage to tree bark.
- D. Grubbing:

1. Perform grubbing work beneath new roads, driveways, walks, seeded areas and other areas and as directed by the Engineer.
 2. Grub out all sod, vegetation and other objectionable material to a minimum depth of 12 inches below the existing grade.
 3. Completely remove all stumps, including major root systems.
- E. Disposal:
1. Remove from the site and dispose of material not being burned.
 2. Provide an approved disposal area unless otherwise specified.
- F. Burning:
1. Dispose of combustible materials by burning, only if approved by local and state officials.
 2. Employ competent workmen to perform burning work in such a manner and at such locations that adjacent properties, trees and growth to remain, overhead cables, wires and utilities will not be jeopardized.
 3. Do not leave fires unguarded.
 4. Do not burn poison oak, poison ivy or other plants of similar nature.
 5. Do not use tires or other combustible waste material to augment burning.
 6. Burn combustible materials daily as the work progresses.
 7. The Contractor shall be responsible for all damage caused by burning and shall be responsible for obtaining all necessary permits for burning.

3.3 REPLACEMENT OF MATERIALS

- A. Paving, Curbing and Miscellaneous Material:
1. Remove all paving, subpaving, curbing, gutters, brick, paving block, granite curbing, flagging and minor structures that are over the area to be filled or excavated.
 2. Remove and replace bituminous asphaltic and portland cement concrete in accordance with the appropriate sections of these Specifications.
 3. Properly store and preserve all material to be replaced in a location approved by the Engineer.
- B. Shrubs and Bushes:
1. Remove, store, and replace ornamental shrubs and bushes to be preserved in accordance with accepted horticultural practices.
- C. Topsoil:
1. When applicable, carefully remove, store, and protect topsoil in accordance with the appropriate section of this division.
- D. Responsibility:
1. Replace, at no additional cost to the Owner, materials lost or damaged because of careless removal or neglectful or wasteful storage, disposal or use of these materials.

END OF SECTION

SECTION 02156TEMPORARY EXCAVATION SUPPORT SYSTEMPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Design, furnish, install, maintain, and remove temporary excavation support system as required to comply with all applicable State and Federal regulations including the Occupational Safety and Health Act. Excavation support system shall consist of steel sheeting, pile and lagging bracing or other systems designed by the Contractor.
- B. Related Work Specified Elsewhere (When Applicable):
 - 1. Section 02200 Earthwork
 - 2. Section 02401 Temporary Dewatering System
 - 3. Geotechnical Data Report is provided in the Appendices.

1.2 DESIGN REQUIREMENTS

- A. The Contractor shall be responsible for the design and construction of the excavation support structures. The excavation support structures (sheeting systems or other special excavation techniques) shall be properly designed by a Professional Engineer registered in the State in which the project is located, who practices in a discipline applicable to excavation work and has more than 5 years of experience in the design of excavation support systems. The excavation support system shall be designed to accommodate an additional 2 feet of excavation below the bottom of excavation shown on the Contract Drawings.
- B. The excavation support system shall be designed and installed to limit the upward hydraulic gradient into the bottom of the excavation and to sustain all existing and expected loads and utilities, to prevent migration of fine grained materials into the excavation, to prevent all movement to earth which could in any way cause injury to workmen, delay the work or endanger adjacent structures. If detrimental effects result from construction activities, the Contractor shall modify the design, revise construction procedures and/or take measures to mitigate and abate further movement at no cost to the Owner.
- C. The Contractor shall prepare an excavation support system monitoring plan intended to monitor the performance of the excavation support system, as well as the adjacent grade and adjacent structures, throughout construction. The excavation support system monitoring plan shall include vibration and deformation monitoring. Contractor shall retain the services of a qualified vibration monitoring consultant to perform vibration monitoring during installation and removal of the excavation support system. Refer to Paragraphs 1.3 and 3.4 for additional requirements.
- D. The internal lateral bracing shall be located so that the braces shall not pass through walls and/or slabs of existing or proposed structures.
- E. The support system shall provide adequate room to properly perform the installation and to allow for inspection of the installation.
- F. Prior to the installation of any portion of the temporary lateral support system, the

Contractor shall furnish to the Owner precondition surveys documenting the existing conditions of the adjacent structures.

- G. The use of existing structures to support the sheeting bracing or structural framing shall be prohibited.

1.3 SUBMITTALS

- A. Provide submittals in accordance with Specification Section 01340.
- B. Submit qualifications of temporary excavation support system design engineer.
- C. Submit attached certificate of design and complete scaled and dimensioned layout drawings of the proposed excavation system, stamped and sealed by a Professional Engineer registered in the State in which the project is located. Drawings shall show plan, sections and elevations of the support system as well as the proposed structures. Submittal shall identify:
 - 1. Physical location on the site and identify any existing utilities, site piping, site electrical conduit that must be relocated prior to excavation support system installation.
 - 2. Type and location of any surcharge loads adjacent to the excavation support system required by the Contractor to execute the work (e.g., excavators, trucks, cranes, soil piles, etc.).
 - 3. Design calculations, supporting documentation and materials cut sheets.
 - 4. Sample monitoring log.
 - 5. System removal requirements.
- D. Submit excavation support system monitoring plan, including qualifications of Contractor's vibration monitoring consultant and Contractor's surveyor. The excavation support system monitoring plan shall identify: the specific method, location and frequency of measurements (pre-, during and post-construction); individual(s) responsible for inspection/measurements; submittal and maintenance of on-site records; and threshold vibration values and excavation support system deformation values that, if exceeded, will require immediate stoppage of work and the performance of repairs necessary for reinstatement of a functional system. Provide justification for recommended vibration and deformation tolerances, on a structure-by-structure basis.
- E. The Contractor shall have sole responsibility for design, construction, monitoring and removal of the excavation support system as necessary to prevent damage to adjacent structures, utilities, streets adjacent to excavations and for safety of persons working within the excavated areas. The submittals will be reviewed for consistency with the design intent.
- F. Submittals under this Section shall be provided concurrently with and coordinated with the submittals under Section 02401 (Temporary Dewatering System).

PART 2 - PRODUCTS

2.1 MATERIAL

- A. All materials shall conform to all applicable State and Federal regulations including the Occupational Safety and Health Act.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Perform preparatory work to discover, protect, maintain and restore utilities, foundations or other facilities located in close proximity of the proposed excavation lateral support system.
- B. Conduct pre-excavation to remove obstructions along the alignment of the excavation lateral support system which will interfere with installation of the excavation lateral support system.
- C. Install the excavation support system, including the installed wall and bracing system, outside the limits of the permanent structure. Construction tolerances (e.g., wall verticality) and lateral wall deflections as a result of excavation and other activities shall be considered in determining the plan location.
- D. Excavation shall not proceed more than 2 ft. below the bracing level, anywhere within the excavation support limits, until the entire level of bracing is completely installed.
- E. The first level of bracing shall be installed within 5 ft. of the ground surface prior to any excavation below this level.

3.2 INSTALLATION

- A. Install excavation support system in accordance with all applicable State and Federal regulations including the Occupational Safety and Health Act. The excavation support system design engineer shall visit the site during excavation support system installation.

3.3 INTERNAL LATERAL WALL BRACING (RAKERS, WALES AND STRUTS)

- A. Rakers are only allowed for the temporary lateral brace that is installed within 5 ft. of the ground surface.
- B. Use wales, struts, corner braces to provide support of the excavation lateral support walls as required. Include web stiffeners, plates, brackets, or angles as required to prevent rotation, crippling or buckling of connections and points of bearing between structural steel members. Allow for eccentricities due to fabrication and assembly. Consider effects of temperature changes.
- C. Install and maintain all support members in continuous tight contact with each other and with the wall being supported.
- D. Preload all bracing members (including rakers, corner braces, and struts) in accordance with methods, procedures and sequence as described on the reviewed shop drawings. Coordinate excavation work with installation of bracing and preloading. Use steel shims and steel wedges, welded or bolted in place, to maintain the preloading force in the bracing after release of the jacking equipment pressure. Wood shims or wedges shall not be used. Braces shall be preloaded to 50 percent of the maximum design load. Provide means to control the fluctuation of loading due to temperature variations.
- E. Accomplish preloading by jacking struts, rakers, etc. in place against the excavation lateral support system walls, or by other methods acceptable to the Owner or Owner's Representative.

3.4 MONITORING

- A. Contractor shall implement the excavation support system monitoring plan intended to monitor the performance of the excavation support system, as well as adjacent grade and adjacent structures, throughout construction. Monitoring shall include the following at a minimum:
 - 1. Pre-Installation Structure Elevation Survey. Conduct survey prior to excavation support system installation.
 - 2. Vibration monitoring (full time) during excavation support system install.
 - 3. Installation Structure and Support System Surveys. Conduct surveys after excavation support system installation but prior to first brace installation; at mid-point of excavation; and at bottom of excavation. Conduct surveys at weekly intervals during structure construction. Conduct survey prior to excavation support system removal. Each survey shall assess the support system deformation and key structures.
 - 4. Vibration monitoring (full time) during excavation support system removal.
 - 5. Post-Installation Structure Survey. Conduct survey after removal of excavation support system.
 - 6. No movement of or damage to adjacent structures shall be allowed.
- B. The excavation support system design engineer shall visit the site during the monitoring program at periodic intervals.
- C. Additionally, if the excavation support system monitoring criteria/requirements are not satisfied due to inadequacy or failure of the excavation support system (settlement of adjacent grade, settlement of structures, cracking of structures, etc.), immediately stop work and perform repairs necessary for reinstatement of a functional system, as well as restoration of foundation soil and damaged structure resulting from such inadequacy or failure by Contractor, at no additional cost to Owner.

3.5 REMOVAL OF SHEETING

- A. Remove all sheeting and bracing unless the removal may cause injury to adjacent structures and/or property.
- B. The General Contractor shall be responsible for repairing all damage to existing structures caused by the removal of sheeting. The excavation support system design engineer shall visit the site during excavation support system removal.
- C. All backfill disturbed by the removal of the sheeting shall be re-compacted to its in-situ density.
- D. Proceed with backfilling as specified in these Specifications. When the level of compacted backfill reaches the location of bracing and wales, remove these items from the trench or other excavation. When the level of the backfill reaches a point three feet below the existing ground grade, remove the sheeting by approved methods and equipment.
- E. After removing the sheeting, complete backfilling in the usual manner.
- F. If the Contractor elects to leave the sheeting or any component of the temporary support system in place, the Contractor shall cut the sheeting or such component at least 4 feet below the ground surface, or as directed by the Engineer.

CERTIFICATE OF DESIGN

RE: Contract between
OWNER: _____
(Name)
and
CONTRACTOR: _____
(Name)
on
CONTRACT: _____
(Title)

(Number) (Date)

The undersigned hereby certify 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 _____
specified in Section _____ of subject contract;
3. Has previously designed comparable excavation support systems;
4. Has prepared the design in full compliance with the requirements of subject contract, including all applicable laws, regulations, rules, and codes – including review and coordination with the Dewatering System design; and
5. Will inspect and supervise installation of the excavation support system, will monitor the in-place system to confirm that the system is installed and functions in accordance with the design and will inspect and supervise the removal of the excavation support system.

CONTRACTOR

ENGINEER

By: _____
(Signature)

(Name)

(Title)

(Date)

By: _____
(Signature)

(Name)

(Engineering Discipline)

(Date)

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. The use of explosives is specified in the Supplementary Conditions section of this Contract, and in Division 1.
 - 2. Traffic Regulation is specified in Division 1.
 - 3. 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.
 - 4. Section 01400 - Quality Control.
 - 5. 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. 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.
- D. Trenches: Field density test in trenches shall be taken at 75 linear foot intervals on every third lift.
- E. Foundation Wall Backfill: Take at least one (1) field density tests per lift per wall at locations and elevations as designated by the Engineer.

- F. In addition to the above tests the Independent Testing Laboratory will perform additional density tests at locations and times requested by the Engineer.
- G. 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 crushed stone or select fill.

PVC or PE Pipe crushed 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 crushed stone or select fill

PVC or PE
Pipe crushed 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. 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.

- E. 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 02260FILTER FABRICPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. Furnish all materials and install filter fabric of the types, dimensions and in the location(s) shown on the Drawings and specified herein.

B. Related Work Specified Elsewhere:

1. Temporary Erosion Control, Riprap and Stone Ditch Protection, and Gabions and Revet Mattresses are specified in the appropriate sections of this Division.

1.2 QUALITY ASSURANCE

A. A competent laboratory must be maintained by the manufacturer of the fabric at the point of manufacture to ensure quality control.

B. During all periods of shipment and storage, the fabric shall be wrapped in a heavy duty protective covering to protect the fabric from direct sunlight, ultraviolet rays, temperatures greater than 140-Deg F, mud, dirt, dust and debris.

1.3 SUBMITTALS

A. Manufacturer shall furnish certified test reports with each shipment of material attesting that the fabric meets the requirements of this Specification

PART 2 - PRODUCTS2.1 MATERIALS

A. Filter fabric for use in stabilization, drainage, underdrains, landscaping and beneath structures shall be formed in widths of not less than six (6) feet and shall meet the requirements of Table 1. Both woven and non-woven geotextiles are acceptable; however no "slit-tape" woven fabrics will be permitted for drainage, underdrain, and erosion control applications.

TABLE 1

<u>Geotextile Mechanical Property</u>	<u>Test Method</u>	<u>Minimum Permissible Value</u>
Grab Tensile Strength (both directions)	ASTM D4595-86	120 pounds
Grab Elongation	ASTM D4632-86	50 percent
Mullen Burst Strength	ASTM D3786-87	210 psi
Puncture Strength	ASTM D3787	60 pounds
Trapezoid Tear Strength	ASTM D4533-85	50 pounds
Water Flow Rate	ASTM D4491-85	120 gal/min/sf
Equivalent Opening Size (EOS)	ASTM D4751	U.S. Std. Sieve #80
Coefficient of Permeability	ASTM D4491-85	0.2 cm/sec

The geotextile shall have property values expressed in "typical" values that meet or exceed the values stated above as determined by the most recent test methods specified above.

- B. Filter fabric for use in reinforcement shall meet the requirements of Table 2. Woven and non-woven geotextiles are acceptable.

TABLE 2

<u>Geotextile Mechanical Property</u>	<u>Test Method</u>	<u>Minimum Permissible Value</u>
Grab Tensile Strength (both directions)	ASTM 4595-86	195 pounds
Grab Elongation	ASTM D4632-86	20 percent
Mullen Burst Strength	ASTM D3786-87	340 psi
Puncture Strength	ASTM D3787	85 pounds
Trapezoid Tear Strength	ASTM D4533-85	85 pounds
Equivalent Opening Size (EOS)	ASTM D4751	U.S. Std. Sieve number(s) between #20 and #100

The geotextile shall meet or exceed the "typical" values stated above as determined by the most recent test methods specified above.

- C. For Silt Fence, refer to Section 02270 - Temporary Erosion Control Execution

PART 3 - EXECUTION

- 3.1 Install filter fabric as shown on the drawings or as directed in appropriate specifications in this division or in accordance with manufacturer's instructions or as directed by the engineer.

END OF SECTION

SECTION 02270TEMPORARY EROSION CONTROLPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. The work under this section shall include provision of all labor, equipment, materials and maintenance of temporary erosion control devices as specified herein, and as directed by the Engineer.
2. Erosion control measures shall be provided as necessary to correct conditions that develop prior to the completion of permanent erosion control devices or as required to control erosion that occurs during normal construction operations.
3. Construction operations shall comply with all federal, state and local regulations pertaining to erosion control.
4. After awarded the Contract, prior to commencement of construction activities, meet with the Engineer to discuss erosion control requirements and develop a mutual understanding relative to details of erosion control.

B. Related Work Specified Elsewhere:

1. Site work is specified in appropriate sections of this Division.

C. Design Criteria:

1. Conduct all construction in a manner and sequence that causes the least practical disturbance of the physical environment.
2. Stabilize disturbed earth surfaces in the shortest time and employ such temporary erosion control devices as may be necessary until such time as adequate soil stabilization has been achieved.

1.2 SUBMITTALS

- A. The Contractor shall furnish the Engineer, in writing, his work plan giving proposed locations for storage of topsoil and excavated material before beginning construction. A schedule of work shall accompany the work plan. Acceptance of this plan will not relieve the Contractor of the responsibility of completion of the work as specified.

PART 2 - PRODUCTS2.1 MATERIALS

A. Baled Hay:

1. At least 14" by 18" by 30" securely tied to form a firm bale, staked as necessary to hold the bale in place.

B. Sand Bags:

1. Heavy cloth bags of approximately one cubic foot capacity filled with sand or gravel.

C. Mulches:

1. Loose hay, straw, peat moss, wood chips, bark mulch, crushed stone, wood excelsior, or wood fiber cellulose.

2. Type and use shall be as specified by the "Connecticut Guidelines for Soil Erosion and Sediment Control" prepared by the Connecticut Council on Soil and Water Conservation herein after referred to as the CTGSESC.
- D. Mats and Nettings:
1. Twisted Craft paper, yarn, jute, excelsior wood fiber mats, glass fiber and plastic film.
 2. Type and use shall be as specified in the CTGSESC.
- E. Permanent Seed:
1. Conservation mix appropriate to the predominant soil conditions as specified in Figure PS-2 and/or PS-3 on pages 5-3-8 through 5-3-11 in the CTGSESC and subject to approval by the Engineer.
- F. Temporary Seeding:
1. Use species appropriate for soil conditions and season as specified in Figure TS-2 on page 5-3-4 of the CTGSESC and subject to approval by the Engineer.
- G. Water:
1. The Contractor shall provide water and equipment to control dust, as directed by the Engineer.
- H. Silt Fence:
1. Silt Fence shall be one of the commercially available brands, meeting the following requirements:

<u>Geotextile Mechanical Property</u>	<u>Test Method</u>	<u>Minimum Permissible Value</u>
Grab Tensile Strength (both directions)	ASTM D-4632	124 pounds
Puncture Strength	ASTM D-4833	60 pounds
Apparent Opening Size	ASTM D-4751	#30
Flow Rate	ASTM D-4491	8 gal/min/ft ²

2.2 CONSTRUCTION REQUIREMENTS

- A. Temporary Erosion Checks:
1. Temporary erosion checks shall be constructed in ditches and other locations as necessary.
 2. Baled hay, sand bags or siltation fence may be used in an arrangement to fit local conditions.
- B. Temporary Berms:
1. Temporary barriers shall be constructed along the toe of embankments when necessary to prevent erosion and sedimentation.
- C. Temporary Seeding:
1. Temporary seeding shall be in accordance with Figure TS-2 Temporary Seeding Rates and Dates on page 5-3-4 of the CTGSSSESC.

- D. Siltation fences shall consist of porous filter fabric with a wire mesh backing and shall be supported by posts as per manufacturer's recommendations. Fabric shall be approved by the Engineer.
- E. Mulch All Areas Receiving Seeding:
 - Use either wood cellulose fiber mulch (750 lbs/acre); or straw mulch with chemical tack (as per manufacturers specifications). Wetting for small areas may be permitted. Biodegradable netting is recommended in areas to be exposed to drainage flow.
- F. Erosion control matting for slopes and ditches shall be anchored with pegs and/or staples per manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Temporary Erosion Checks:
 - 1. Temporary erosion checks shall be constructed in ditches and at other locations designated by the Engineer. The Engineer may modify the Contractor's arrangement of silt fences, bales and bags to fit local conditions.
 - 2. Baled hay, silt fences, or sandbags, or some combination, may be used in other areas as necessary to inhibit soil erosion.
 - 3. Siltation fence shall be located and installed as shown on plans or as required to comply with all Federal, State and Local Regulations.
- B. Maintenance:
 - 1. Erosion control features shall be installed prior to excavation wherever appropriate. Temporary erosion control features shall remain in place and shall be maintained until a satisfactory growth of grass is established. The Contractor shall be responsible for maintaining erosion control features throughout the life of the construction contract. Maintenance will include periodic inspections by the Owner or Engineer for effectiveness of location, installation and condition with corrective action taken by the Contractor as appropriate.
- C. Removing and Disposing of Materials:
 - 1. When no longer needed, material and devices for temporary erosion control shall be removed and disposed of as approved by the Engineer.
 - 2. When removed, such devices may be reused in other locations provided they are in good condition and suitable to perform the erosion control for which they are intended.
 - 3. When dispersed over adjacent areas, the material shall be scattered to the extent that it causes no unsightly conditions nor creates future maintenance problems.

END OF SECTION

SECTION 02401DEWATERINGPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included:
 - 1. Furnish, operate and maintain, as incidental to the project, dewatering equipment to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry; collect and dispose of ground and surface water where necessary to complete the work.
- B. Related Work Specified Elsewhere: (When Applicable)
 - 1. Earthwork and Sheet piling are specified in the appropriate section in this division.

1.2 SUBMITTALS

- A. Provide submittals in accordance with Specification Section 01340. Submit design calculations, description and complete layout drawings of the proposed dewatering system, stamped and sealed by a Professional Engineer registered in the State of Connecticut. Such review shall not relieve the Contractor of sole responsibility for the dewatering system as necessary to prevent damage and settlement to adjacent structures, utilities, streets adjacent to excavations and for the safety of persons working within the excavated areas.
- B. Submittal shall include: location, depth and size of wellpoints, headers, sumps, ditches; size and location of discharge lines; capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from site to adequate disposal.
- C. Submit letter from dewatering system design engineer that the design of the dewatering system has been fully coordinated with the design of the excavation support system.

1.3 DESIGN

- A. Dewatering system shall be designed by a Professional Engineer registered in the State of Connecticut who is experienced in the design of Dewatering systems
- B. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least one foot below the lowest foundation subgrade or bottom of pipe trench to allow material to be excavated in a dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheet piling is not required. Operate dewatering system continuously until backfill work has been completed.
- C. Control of surface and subsurface water is part of dewatering system requirements. Maintain adequate control so that:
 - 1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase and subgrades where

- underlying materials are not free draining or are subject to swelling or freeze-thaw action.
2. Erosion is controlled.
 3. Flooding of excavations or damage to structures does not occur.
 4. Surface water drains away from excavations.
 5. Excavations are protected from becoming wet from surface water, or insure excavations are dry before additional work is undertaken
 6. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
 7. Maintain stability of sides and bottom of excavation. Construction operations are performed in the dry.
 8. Any existing dewatering wells that can affect dewatering and excavation shall be sealed below the excavation subgrade.
- D. Design shall include an assessment of how the dewatering operations will affect the stability of all adjacent structures
- E. Contractor is responsible to perform whatever additional geotechnical investigations are needed to design the dewatering system to allow for proper construction of new facilities while protecting adjacent structures from damage due to settlement, and in accordance with this specification.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 PERFORMANCE

- A. General:
1. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.
 2. Keep work areas dewatered until the structures, pipes, and appurtenances to be built there have been completed to such an extent that they will not be damaged by water.
 3. Thoroughly brace or otherwise protect against flotation all pipelines and structures which are not stable.
 4. Maintain standby backup equipment and power supply throughout the duration of the dewatering operation.
 5. Prevent soil particles from entering the discharge points.
 6. Ground water level shall be maintained at least one foot below the bottom of the excavation.
- B. Disposal of Water:
1. All dewatering wastewater management and erosion and sediment controls shall conform to the 2002 Connecticut Guidelines for Soil Erosion and sediment Control, as amended.

2. No discharge of dewatering wastewaters shall contain or cause a visible oil sheen, floating solids or foaming in the receiving waters.
 3. Dewatering wastewater discharges shall not cause scouring or erosion or contain suspended solids in amounts that could reasonably be expected to cause pollution of surface waters of the State.
 4. Dispose of water pumped or drained from the construction site in a suitable manner to avoid siltation of adjacent drainage structures and piping, wetlands or water bodies, injury to public health, damage to public and private property, and damage to the work completed or in progress.
 5. Provide suitable temporary channels for water that may flow along or across the construction site.
 6. Provide treatment as necessary to prevent discharge of contaminated ground water caused by Contractor's operations, or any contaminated ground water that may pass through the excavation support system selected by the Contractor.
 7. Contractor must obtain all necessary regulatory approvals for the disposal of dewatering flows. These may include, among others, approval by the USEPA under the National Pollutant Discharge Elimination System (NPDES) program for construction activities.
- C. Damage:
1. Avoid damage to and settlement of adjacent buildings, roads, structures, utilities and other facilities.
 2. Any damage to or settlement of structures resulting from the dewatering operations, or the failure of the Contractor to maintain the work in a suitably dry condition shall be repaired by the Contractor at no additional cost to the Owner.
- D. Temporary Underdrains:
1. When necessary, temporary underdrains may be placed in excavations.
 2. Underdrain pipe shall be perforated corrugated metal, polyethylene or P.V.C. pipe.
 3. Entirely surround the underdrain and fill the space between the underdrain and the pipe or structure with free draining material.
- E. Excavation Sump Pumping:
1. When necessary and where appropriate to the geotechnical conditions encountered, excavations may be over excavated 6 to 12 inches and filled with screened stone to allow sump pumping of groundwater.
 2. The system shall be installed with suitable screens and filters so that pumping of fines does not occur.
- F. Well and Wellpoint System:
1. If necessary, dewater the excavations and trenches with an efficient well or wellpoint system to drain the soil and prevent saturated soil from flowing into the excavated wells and area.
 2. Wellpoint and well system shall be of the type designed for dewatering work and shall be installed with suitable screens and filters so that pumping of fines does not occur.
 3. Pumping units shall be capable of maintaining sufficient suction to handle large volumes of air and water at the same time.

G. Corrective Action:

1. If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged structure resulting from such inadequacy or failure by Contractor, at no additional cost to Owner.

END OF SECTION

SECTION 02444COMMERCIAL ALUMINUM ORNAMENTAL FENCE AND GATESPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. Furnish all materials and install aluminum ornamental fence and gates of the types, sizes and in the location(s) shown on the Drawings and specified herein.

B. Related Work Specified Elsewhere:

1. Cast-in-place concrete is specified in Division 3.

1.2 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. Alumi-Guard, Brooksville, FL.
2. Or equivalent.

1.3 REFERENCES

A. Aluminum Association (AA)

1. ASD-1 – Aluminum Standards and Design
2. DAF-45 – Designation System for Aluminum Finishes

B. American Society for Testing and Materials (ASTM)

1. ASTM A 276 – Standard Specification for Stainless Steel Bars and Shapes.
2. ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
3. ASTM B 221 – Specification for Aluminum-Alloy Extruded Bars, Rods, Wire Shapes and Tubes.
4. ASTM B 429 – Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
5. ASTM D 523 – Standard Test Method for Specular Gloss.
6. ASTM D 1654 – Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
7. ASTM D 2247 – Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
8. ASTM D 2794 – Impact Resistance Test (Rating up to 160 inch lbs.)
9. ASTM D 3359B – Adhesion by Tape Test (Rating = 5B)
10. ASTM D 3363 – Film Hardness by Pencil Test (Rating = 2H)
11. ASTM D 968 – Abrasion Resistance.

C. American Architectural Manufacturers Association (AAMA)

1. AAMA 2605 – Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
2. AAMA 2604 – Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels

2.2 SUBMITTALS

- A. Submit satisfactory guarantees by the fence manufacturer covering any faults and defects in all parts of the fence arising from defective workmanship or materials for a period of one year from the date of installation.

PART 3 - PRODUCTS

3.1 FENCE MATERIALS

- A. Components:
 - 1. Posts: Aluminum extrusions of 6005-T5 alloy in accordance with ASTM B 221.
 - 2. Pickets: Aluminum extrusions of 6063-T52 alloy in accordance with ASTM B 221.
 - 3. Channel: Aluminum extrusions of 6005-T5 alloy in accordance with ASTM B 221.
- B. Fasteners:
 - 1. Screws of 410 and 18-8 stainless steel conforming to ASTM A276, with self-drilling head.
 - 2. Screws painted to match the finish of fence.
- C. Accessories:
 - 1. Post caps, wall brackets, scrolls, finials, flanges and other miscellaneous hardware fabricated of aluminum or other non-ferrous metal castings.

3.2 ORNAMENTAL FENCING

- A. Fencing General:
 - 1. Commercial Grade:
 - a. Aluminum Channel Sections: 1-1/4 inch deep and 1-1/4 inch wide with top 0.062 inch and sidewalls 0.078 inch wall thickness. With decorative top corner.
 - b. Pickets 3/4 inch by 3/4 inch with a 0.050 inch wall thickness.
 - 2. Post Length:
 - a. As required to allow setting of post into the ground with approximately 1-3/4 inches (305 mm) between bottom of panel and ground.
- B. Ornamental Fencing:
 - 1. Style: Based on Alumi-Guard Ascot:
 - a. Grade:
 - i. Commercial.
 - b. Channels:
 - i. 2 Channel.
 - c. Commercial and Concealed Fastener Picket Spacing:
 - i. Standard: 3.875 inches.
 - d. Panel Length: Inside posts.
 - i. Commercial Nominal 68.62 inches.
 - e. Posts:
 - i. 4 inches by 4 inches.
 - (1) .125 inch wall thickness.
 - f. Panel Height:
 - g. 60 inches.

- C. Ornamental Gates: Provide to match ornamental style specified.
 - 1. Height:
 - a. 60 inches.
 - 2. Opening Width: Inside posts.
 - a. Single 36 inches.
 - b. Double 36 inches, 72 inch opening.
 - 3. Hardware:
 - a. Self Closing Hinges.
 - b. Gravity Latch.
 - c. Lock bolt for one leaf of double gates.
 - d. Single Hole Lock Box.
 - e. Magna-Latch.

PART 4 - EXECUTION

4.1 FINISH

- A. Fence and Accessory Finish:
 - 1. SuperDurable Polyester Powder Coating: High performance polyester, medium gloss, applied to over 2 mils thickness and complying with AAMA 2604.
 - 2. Fluoropolymers: Superior performance polyester power coating, medium gloss, applied to 3-4 mils thickness and complying with AAMA 2605.
 - 3. Color to be selected by the Owner.
- B. Performance:
 - 1. Meet or exceed a 4000 hour salt spray test.
 - 2. SuperDurable Polyester Powder Coating meets or exceeds a H-2H pencil hardness in accordance to ASTM D 3363.
 - 3. Meets or exceeds ASTM D 3359 adhesion test.

4.2 FABRICATION

- A. Stringers, (Horizontal rails) shall be punched to allow pickets to pass through the top of the rail. The number of stringers shall vary with the style, height and strength as determined by manufacturer.
- B. Pickets, shall be fastened to stringers mechanically with stainless steel TEK screws on one side of the stringer only.
- C. Posts, shall be pre-punched to allow the stringers to slide in and be attached with stainless steel TEK. Cast aluminum post caps shall be affixed to all posts.
- D. Gates, shall be fabricated using the same components as for the complete fencing system. Walk gates shall have adjustable self-closing hinges and will be self-latching. (Specify style and dimensions.)
- E. Assembled 3-Channel 72" high fence panels/sections shall support a min. vertical load of 270 lbs. at midspan. 36" high sections shall support a min. vertical load of 500 lbs. at midspan.

4.3 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare the grade and remove surface irregularities, if any, which may cause

interference with the installation of aluminum fence.

- C. If preparation and condition is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

4.4 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials.
- C. Provide excavation for post length to suit local conditions for proper anchorage and stability.
- D. Center and align posts in excavated holes to required depth. Place concrete around posts, and vibrate or tamp for consolidation. Re-check vertical and top alignment of posts, verify they are plumb and level. Make necessary corrections if needed before concrete hardens.
- E. If fence is deck mounted on existing hard surfaces. Set posts plumb, to tolerances specified. Locate mounting locations prior to start of work. Avoid mounting over expansion or control joints. Use non-corrosive fasteners suitable for the material to which it is to be mounted.
- F. Insert notched stringers into pre-punched posts and fasten with stainless steel TEK screws.
- G. Support gates from gate posts. Do not attach hinged side of gate from building wall.
- H. Provide concrete center drop for drop rod retainers at center of double gate openings.
- I. Install gates plumb, level and secure for full opening without interference. For double gates, install drop rod. Adjust all hardware for smooth operation.

4.5 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From Indicated Position: 1 inch.
- C. Minimum distance from property line: 6 inches.

4.6 CLEANING

- A. Leave immediate work area neat at end of each work day.
- B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- C. Clean aluminum fence with mild household detergent and clean water rinse well. Mortar should be removed from exposed posts and other fencing material using a 10% solution of muriatic acid followed immediately by several rinses with clean water.
- D. Touch up scratched surfaces using materials recommended by manufacturer. Match touchup paint color to fence finish.

4.7 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 02480LANDSCAPINGPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. Perform the following items of work as required to complete the work of this section as shown on the Drawings and as specified hereunder:
 - a. Spread stockpiled topsoil and furnish and spread any additional topsoil, required to meet the requirements of this section.
 - b. Furnish and sow grass seed/or sod in all areas within the work area to the extent indicated on the Drawings, and in existing grass areas which have been damaged or disturbed by the work of this Contract.
 - c. Furnish and install plant materials in all areas within the work area as indicated on the Drawings.
 - d. Provide maintenance services as specified hereunder.
- B. Examine all other sections of the Specifications and all Drawings for the relationship of the work under this section and the work of other trades. Cooperate with all trades in performing the work under this section.

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. 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. It is the intent of this section that all topsoil which can be recovered from the site shall be used. Furnish additional topsoil as required.
 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 for agricultural use.
 5. Approval, by the Engineer, to use topsoil for use in the work will be dependent upon the results of the soils tests.

- C. Lime and 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 AND 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:

1. 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 and Planting:

1. Work Seasons - Perform seeding and planting work only between the dates of 1 May to 20 June and 15 August to 1 October, except as otherwise directed in writing by the Engineer.
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 FOR GRADING AND SEEDING

A. 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.

B. Fertilizer:

1. Fertilizer shall be used to counteract soil deficiencies as indicated by the soil analysis and as approved by the Engineer. It should be a complete fertilizer, a standard product complying with the state and federal fertilizer laws, part of the elements of which are derived from organic sources, containing the following percentages by weight:

Nitrogen	10N - Minimum 75 percent organic
Phosphorus	6 P -
Potash	4 K -

The fertilizer shall be delivered to the site in the original unopened containers bearing the manufacturer's guaranteed statement of analysis, or a manufacturer's certificate of compliance covering analysis shall be furnished to the Engineer. The fertilizer shall be spread at the rate of 17 to 20 lbs/1000 sq-ft.

C. Lime:

1. Provide lime which is ground limestone containing not less than 85 percent of total carbonate and of such fineness that 90 percent will pass a No. 20 sieve and 50 percent 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. Soil Enrichers:

1. They shall be one of the following materials:
 - a. Peat Moss - Finely shredded and consisting of not less than 90 percent organic matter.
 - b. Sawdust - rotten.
2. They shall be natural and suited to horticultural use. They shall not contain lumps, roots or other foreign matter over two inches in diameter. They shall be free from noxious weeds, seeds and other elements harmful to lawns. They shall be subject to inspection approval by the Engineer at the source and upon delivery and shall contain not more than 35 percent moisture by weight at the time of incorporation into the soil.

E. Mulch for Hydro Seeding:

1. Mulch material shall meet the following requirements:

- a. Hay or straw - Hay or straw mulch shall consist of long fibered hay or straw, reasonably free from noxious weeds or other undesirable material. No material shall be used which is so wet, decayed, or compacted as to inhibit even and uniform spreading. No chopped hay, grass clippings or other short fibered material shall be used unless directed.
 - b. Wood cellulose fiber - Wood cellulose fiber mulch shall consist of natural wood cellulose fiber containing no materials which will inhibit seed germination or plant growth. Sufficient non-toxic water soluble green dye shall be added to provide a definite color contrast to the ground surface to aid in even distribution. Wood fiber mulch shall be supplied in uniform packages not exceeding 100 pounds each. Each package shall be marked to show the air dry weight.
- F. Mulch Binder for Hydroseeding:
1. Material for mulch binder shall be emulsified asphalt.
 - a. Emulsified asphalt mulch binder shall be a type acceptable to the Engineer and may be diluted with water to assure even distribution.
- G. Grass Seed Mixture
1. Fresh, clean, new crop seed. Seed may be mixed by an approved method on the site, or may be mixed by the dealer. If the seed is mixed on the site, each variety shall be delivered in the original containers which shall bear the dealer's guaranteed statement of the composition of the mixture and the percentage of purity of each variety. The Dealers Guarantee Statement shall be delivered to the Engineer.
 2. Grass seed shall be composed of the following varieties which shall be mixed in the proportions and shall test to the requirements of CT DOT Form 816 Section M.13.01- Seed Mixture.
Percent Proportion by Weight:
 - a. CTDOT Mixture:
 - i. Chewing fescue 35 percent
 - ii. Hard fescue 30 percent
 - iii. Colonial Bentgrass 5 percent
 - iv. Birdsfoot Trefoil 10 percent
 - v. Perennial Ryegrass 20 percent
 - b. CTDOT Temporary Mixture:
Perennial Ryegrass (*Lolium Perenne*) or an improved variety thereof such as Manhattan having a minimum purity of 98% and a minimum germination of 90%.
 - c. Lawn Areas, stormwater basin areas, stockpile areas and related shall be selected and require approval by the ENGINEER prior to placement. Seed mixtures are to be selected from Figure PS-2 and/or PS-3 as located within the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control.
- H. Sod:
1. Preferable two year growth, at least 85 percent weed-free, solid landscaping sod composed of perennial fescues, Kentucky bluegrass's. Submit one 12 by 12 inch piece of sod, with source location, for approval of the Engineer, before ordering sod for the work.

2.2 MATERIALS FOR PLANTING

- A. Water:
 - 1. The Contractor shall arrange and pay for water required for the planting. Water shall be clean and suitable for domestic consumption.
- B. Manure:
 - 1. Manure shall be well rotted, unleached, horse or cow manure or a combination of both. It shall be free from any chemicals used to hasten decomposition artificially, or any other injurious substance.
 - 2. Manure shall be at least nine months old and not more than two years old, free from sawdust, hay, tanbark or wood shavings, or refuse of any kind. Manure shall consist of not more than 25 percent straw or other acceptable material.
- C. Stakes shall be white cedar or approved equal, of size and length as shown on the Drawings.
- D. Hose for guying shall be new black or green two-ply fiber garden hose, not less than 1/2 inch inside diameter. Seconds rejected by the factory are acceptable.
- E. Burlap for wrapping shall be first quality burlap at least eight ounces in weight and six inches in width.
- F. Wire for tree guys shall be galvanized annealed steel wire, No. 14 gauge, as detailed.
- G. Tree paint shall be waterproof, adhesive and elastic, free from kerosene, coal tar creosote or any other material injurious to the life of the trees. Tree paint shall contain an antiseptic.
- H. Pine bark mulch shall be clean, shredded, free of weeds, seeds, insects and extraneous materials.
- I. Plant Materials:
 - 1. Plant materials shall conform to American Standard for Nursery Stock (April 15, 1951), sponsored by the American Association of Nurserymen, Inc., Standard Plant Names (1942) shall be the authority for plant names. Plant materials shall be of standard quality true to name and type and first class representatives of their species or variety.
 - 2. All plants shall conform to the varieties specified in the Plant List. No substitutions will be permitted unless approved in writing by the Engineer. Each bundle of plants and all separate plants shall be properly identified by name on legible, waterproof labels, securely attached thereto before delivery to the site.
 - 3. Plant materials shall be free of damage as a result of handling and transportation.
 - 4. All plant material shall be certified by the supplier to be free of disease and infestation.
 - 5. All plants shall be subject to approval at their source prior to shipment. The Contractor shall accompany the Engineer to inspect the materials, and shall request such inspection at least one week in advance.
 - 6. All plants shall be typical of their species or variety and shall have a normal habit of growth. They shall be first quality, sound, healthy, vigorous, well branched and densely foliated. They shall be free of disease, insect pests, eggs or larvae, and shall have healthy, well furnished root systems. Plants lacking

- compactness or proper proportions, and plants injured by too close planting in nursery rows will not be accepted.
7. All plants shall conform to the measurements specified in the Plant List. Measurements specified shall be the minimum acceptable for each variety. Plants that meet these requirements specified, but do not possess a normal balance between height and spread, will not be accepted. Plants shall not be pruned prior to delivery.
 8. All plants and all tree trunks shall be measured when the branches are in their normal position. Dimensions noted for height and spread refer to the main body of the plant, and not from branch tip to branch tip. Height is defined as the approximate dimension from ground to top of last year's growth. Top spread is defined as the approximate spread to top or principal width. The height of tree trunks need not be specified if the required height can be obtained by pruning the lower branches without leaving unsightly scars or otherwise damaging the trunk. Shade trees shall be free of branches up to five feet, with a single leader, well branched and reasonably straight stems. No trees which have had their leaders cut, or are so damaged that cutting is necessary, will be accepted. Trees which had their tops cut off some years previous will only be acceptable if the scar has not decayed. No trees with cut off tops will be accepted unless corrective surgery has been performed so as to effect a complete healing of the stem.
 9. Caliper of trees shall be measured one foot above ground.
 10. Plants larger in size than those specified in the Plant List may be provided if approved by the Owner or the Engineer, but the use of larger plants shall not increase the cost of the Contract. If the use of larger plants is approved, the ball of earth or spread of roots shall be increased in proportion to the size of the plant. If plants required to be bare rooted are furnished in sizes greater than specified, they shall be balled and burlapped.
 11. All trees shall have straight trunks with single leader intact. There shall be no abrasion of the bark and no fresh cuts of limbs over 1-1/4 inch which have not completely callused over.
 12. All plants shall be grown in nurseries and cultivated, sprayed, pruned, and fertilized annually in accordance with good horticultural practice. All plants shall have been grown under climatic conditions similar to those in the locality of the project, or shall have been acclimated to the conditions of the locality for at least two years.
 13. All plants shall be freshly dug; neither heeled in plants nor plants from cold storage will be accepted. All plants shall have been transplanted or root pruned at least once in the past three years. Balled and burlapped plants shall come from soil which will hold a firm ball.
 14. Plants marked "B&B" in the Plant List shall be adequately balled and burlapped with firm natural balls of soil, of diameter of sufficient depth to include all the roots. No plant required to be balled and burlapped shall be accepted if the ball is cracked or broken either before or during the process of planting, or when burlap, stakes, ropes or platform required in this connection have been removed.

15. All plants shall be handled so that the roots are adequately protected at all times. During shipment all plants shall be properly protected by a tarpaulin or other suitable covering.
16. No plants shall be so bound with rope or wire at any time so as to damage the bark, break branches, or destroy its natural shape. All balled and burlapped plants which cannot be planted immediately on delivery shall be set on the ground and well protected with soil or other acceptable material including watering. Until planted, all material shall be properly maintained.

2.3 STORAGE OF MATERIAL

- A. Materials such as fertilizers, ground limestone, etc. shall be stored in weatherproof storage areas and in such a manner that their effectiveness will not be impaired.

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. Subsoil Preparation:
 1. Before spreading topsoil, the subgrade shall be raked by approved means. Remove all stones greater than four inches and all debris or rubbish to a depth of six inches. Such materials shall be removed from the site.
- C. Screening:
 1. All topsoil shall be screened clear of all stones greater than one inch, sticks, plants, and all other foreign materials before being spread.
 2. During the screening of topsoil, commercial fertilizers and lime as required by the soil analysis shall be mixed with the topsoil so that they are evenly distributed throughout the screened topsoil.
 3. At the completion of this operation, topsoil is referred to as improved topsoil for the purpose of this specification and the Drawings.

3.2 SEED AND SOD BED PREPARATION

- A. Spread improved topsoil uniformly over subgrade and all areas where the existing grade has been changed and areas disturbed by construction operations except for those areas indicated on the site plans to be paved. No subsoil, topsoil, or improved topsoil shall be handled in any way when in a wet or frozen condition.
- B. Fine rake surface to receive seed or sod.
- C. After natural settlement and a light rolling, the completed work shall conform to the lines, grades, pitches, and spot elevations shown on the plans.
- D. Seeding may be done immediately thereafter, provided the seed bed has remained in a good friable condition and has not become wet.

3.3 SEASON

- A. Do all seeding work within the dates herein specified.

- B. If special conditions exist which may warrant a variance in the above dates, submit a written request to the Engineer stating the conditions and proposed variance. Permission for the variance will be given if, in the opinion of the Engineer, the variance is warranted.
- C. If seeding is authorized between May 15 and August 15, annual rye shall be sown separately in addition to the specified seed mix. Sow at the rate of six to eight pounds per 1000 square feet.

3.4 SEEDING AND SODDING

- A. Immediately before seeding and sodding, the ground shall be restored as necessary to a loose friable condition by discing or other approved method to a depth of not less than two inches. The surface shall be cleared of all debris and of all stones one inch or more in diameter.
- B. Seed all areas to be seeded with the specified grass seed, sowing evenly with an approved mechanical seeder at the rate specified in the seed mix schedule. Sow one half the seed in one direction and the other half at right angles to the first seeding. Cultipacker or approved similar equipment may be used to cover the seed and to firm the seed bed in one operation. In areas inaccessible to Cultipacker, the seeded ground shall be lightly raked and rolled in two directions with a water ballast roller. Extreme care shall be taken during seeding and raking to insure that no change shall occur in the finished grades and that the seed is not raked from one spot to another.
- C. The hydraulic spray method of sowing seed may be used where approved by the Engineer. This work shall be done with an approved machine operated by a competent crew. Seed and fertilizing materials shall be mixed with water in the tank of the machine and kept thoroughly agitated so the materials are uniformly mixed and suspended in the water at all times during operation. 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. If the Engineer finds the application uneven or otherwise unsatisfactory, he may require the hydraulic spray method to be abandoned and the balance of the work done as specified herein. Seed must be lightly raked into the surface of the soil unless seeding is to be followed within 24 hours by mulching.
 - 1. Applying Mulch - At the option of the Contractor, any of the following types of mulch material may be applied.
 - a. Hay or straw mulch shall be spread evenly and uniformly over the designated areas. Unless other directed, mulch shall be applied to a thickness of 1". Too heavy application of mulch shall be avoided and lumps and thick spots shall be thinned. Unless otherwise authorized, the mulch shall be anchored in place by uniformly applying an asphalt mulch binder. Application of a concentrated stream of mulch binder will not be allowed. Asphalt mulch binder may be omitted when authorized by the Engineer and when there is a danger of the asphalt contaminating the surface of nearby structures, houses, vehicles, or other objects. Other methods of anchoring mulch may be used subject to the approval of the Engineer.
 - b. Wood fiber mulch shall be applied as a water-borne slurry. The wood fiber and water shall be thoroughly mixed and sprayed on the area to be

- covered so as to form a uniform mat of mulch at the rate of not less than 30 pounds per 1,000 square feet unit of area. Wood fiber mulch may be mixed with the proper quantities of seed, fertilizer and lime as required in this section, or may be applied separately after seeding has been carried out. In the latter case, it must be applied within 24 hours after seeding.
2. Maintenance - The Contractor shall maintain the mulch by repairing any damaged mulch and by correcting any shifting of the mulch due to wind, water or other causes, until an acceptable growth of grass has been achieved, regardless of the acceptance status of the seeding. He shall supply additional mulch necessary as a result of damage or seed failure. Repairs to mulched areas and furnishing of additional mulch shall be incidental to this item. If wood fiber is used, any reseeding will require additional wood fiber mulch.
- D. Do not perform broadcast seeding work during windy weather.
- E. Compacting:
1. Compact the entire area immediately after the seeding operations have been completed.
 2. Compact by means of a cultipacker, roller, or other equipment approved by the Engineer weighing 60 to 90 pounds per linear foot of roller.
 3. 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.
 4. 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.
- F. Thoroughly wet soil surfaces before sodding. Place sod pieces tightly together, tamping gently into position as the work progresses. After each area of sodding is completed, roll the entire surface in two directions with a water ballast roller, and soak the newly sodded areas.
- G. After the grass has started, all of the areas greater than five square feet which fail to show a uniform stand of grass for any reason whatsoever shall be reseeded repeatedly until all areas are covered with a satisfactory growth of grass.
- H. At the time of the first cutting, set mower blades two inches high. All lawns shall receive at least two mowings before acceptance. Schedule for mowing shall be coordinated with the Engineer.
- I. Maintenance shall also include all temporary protection fences, barriers and signs and all other work incidental to proper maintenance.
- J. Maintain grass areas until a full stand of grass is indicated, which will be a minimum of 45 days after all seeding or sodding work is completed, and shall not necessarily relate to Substantial Completion of the General Contract.
- K. 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 of 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.

3.5 SEEDING AND SODDING INSPECTION FOR PROVISIONAL ACCEPTANCE

- A. The Engineer shall inspect all work for Provisional Acceptance upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date of inspection.
- B. Upon completion and reinspection of all repairs or renewals necessary in the judgment of the Engineer, the Engineer shall certify in writing to the Owner as to the Provisional Acceptance of the work of this section.
- C. Upon approval of the Provisional Acceptance by the Owner, the Owner will assume maintenance of the lawn areas.

3.6 GUARANTEE

- A. The Contractor shall submit a written guarantee to the Engineer, after Provisional Acceptance of grass, covering reseeded areas which do not survive through one full growing season after the date of Provisional Acceptance, at no cost to the Owner.

3.7 CLEAN-UP

- A. Any soil or similar material which has been brought on to paved areas by hauling operations or otherwise shall be removed promptly, keeping these areas clean at all time.
- B. Upon completion of work under this section all excess stones, debris, and soil resulting from work under this section, which have not previously been cleaned up, shall be removed from the project site.

3.8 PLANTING METHOD

- A. The Contractor shall excavate plant pits, furnish and place all plants, and then maintain them in a satisfactory manner until final acceptance.
- B. All pits shall be of size and shape as shown on the Drawings.
- C. For tree and shrub planting, soil used for backfilling shall be improved topsoil as recommended by soil analysis, with the following additions:
 - 1. For deciduous plants use a mixture of four parts topsoil and one part of manure.
 - 2. For evergreen plants use a mixture of four parts topsoil and one part of peat moss as specified under Soil Enrichers.
- D. Plant pits within or near paved areas shall be prepared prior to the laying of the pavement. Where tree pits in paved areas are to be covered with mulch, trees shall be placed at sufficient depth below finished grade to allow for the depth of the mulch.
- E. Plants shall be set plumb and straight, and at such a level that after settlement, a normal or natural relationship of the crown of the plant with the ground surface is established. Each plant shall be planted in the center of the pit. When balled, burlapped and platformed plants are set, the platform shall first be removed from the pit and the soil shall be carefully tamped under and around the base of each ball to fill all voids. All burlap, ropes, and wires shall be removed from the sides and tops of balls, but no burlap shall be pulled out from under the balls, except for plastic burlap, which shall be completely removed from the pit.
- F. All seals shall remain unbroken and visible on plant material until final inspection by Engineer. The Contractor shall remove all seals immediately after final inspection.

3.9 PLANTING SEASON

A. Do all planting work within the dates herein specified.

3.10 PRUNING, PAINTING, SPRAYING

A. Pruning:

1. Each tree and shrub planted shall be pruned to preserve the natural character of the plant and in a manner appropriate to the particular requirements of the landscape design. In general, approximately one third of the wood shall be removed by thinning or shortening branches, but no leaders shall be cut.
2. All pruning shall be done with sharp tools. All pruning cuts shall be made flush and clean, especially where lower branches have been removed from collected trees.

B. Painting:

1. Pruning cuts over one-half inch in diameter shall be painted with tree paint specified under "Materials" on all exposed cambium as well as other exposed living tissues.

3.11 STAKING

A. All staking shall be done immediately after wrapping. Stakes shall be driven perpendicular into the ground around the periphery of the ball of the tree. Plants shall stand plumb after staking.

3.12 WATERING

- A. Plantings shall be watered in a satisfactory manner during and immediately after planting, not less than twice per week, until provisional acceptance.
- B. Suitable water for maintaining plants shall be provided by the Owner. The Contractor shall furnish the hose and hose connections from the outlets where water is furnished. Contractor is responsible for all watering until provisional acceptance.

3.13 MAINTENANCE

- A. Maintenance shall begin immediately after each plant is planted. Plants shall be watered, mulched, weeded, fertilized, cultivated and otherwise maintained and protected until provisional acceptance.
- B. Guys shall be tightened and repaired. Defective work shall be corrected as soon as possible after defects become apparent, and weather and season permit.

3.14 TREE SURGERY

A. Existing trees shall be trimmed of all dead and diseased limbs at the direction of the Engineer. All cuts shall be made close to the trunk and those over one inch in diameter shall be covered with an acceptable tree paint manufactured for this specific purpose. In the case of important large trees where a small amount of cavity work would prolong their lives, such work should be done. The services of a qualified tree surgeon are recommended.

3.15 INSPECTION AND PROVISIONAL ACCEPTANCE

A. The Engineer will inspect all planting work for provisional acceptance upon request of the Contractor.

- B. The Contractor shall furnish full and complete written instructions for maintenance of the planting to the Owner at the time of provisional acceptance.
- C. After all necessary corrective work has been completed and maintenance instructions have been received by the Owner, the Engineer will certify in writing the provisional acceptance of the planting.

3.16 GUARANTEE PERIOD

- A. All plants shall be guaranteed by the Contractor for a period of not less than one full year from time of provisional acceptance.
- B. At the issuance of provisional acceptance, the Owner shall take over maintenance of the planting. Nevertheless, the guarantee of all plant material will remain with the Contractor. The Contractor shall ascertain that the Owner properly waters and maintains all planting during the one year guarantee period.
- C. At the end of the guarantee period, any plant that is missing, dead, not true to name or size as specified, or not in satisfactory growth, as determined by the Engineer, shall be replaced. In case of reasonable doubt or question regarding the condition and satisfactory establishment of a rejected plant, the Engineer may allow such a plant to remain through another complete growing season, at which time the rejected plant, if found to be dead, in an unhealthy or badly impaired condition, shall be replaced at once. The Contractor will not be required to replace an inspected and accepted plant more than once.
- D. Replacements shall be plants of the same kind and size as specified in the Plant List. They shall be furnished and planted as specified herein. The cost of replacement shall be borne by the Contractor, except where it can be definitely shown that loss resulted from Owner's failure to maintain planting as instructed.

3.17 FINAL INSPECTION AND FINAL ACCEPTANCE

- A. At the end of the guarantee period, inspection will be made by the Engineer, at the request of the Contractor.
- B. After all necessary corrective work has been completed, the Engineer will certify in writing the final acceptance of the planting.

3.18 CLEAN UP

- A. Upon completion of work under this section, all excess stones, debris and soil resulting from planting work shall be removed from project site. The site shall be restored to a better condition than was present prior to construction.

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:
50 percent Creeping Red Fesque
30 percent Kentucky Bluegrass

- 20 percent Annual Ryegrass
- b. Roadside Mixture:
 - 50 percent Creeping Red Fescue
 - 15 percent Kentucky Bluegrass
 - 5 percent White Clover
 - 2 percent Red Top
 - 3 percent Birdsfoot Trefoil
 - 25 percent Annual Ryegrass
- 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 02513BITUMINOUS CONCRETE PAVING (CONNECTICUT)PART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included:
 - 1. Furnish all plant, labor, equipment and materials required to install bituminous concrete pavement courses, including walkways and driveways, as shown on the Drawings and as specified herein.
- B. Work Not Included: Removal and replacement of paving for the convenience of the Contractor will not be considered for payment.
- C. Related Work Specified Elsewhere (When Applicable):
 - 1. Excavation, backfill, processed aggregate base.

1.2 QUALITY ASSURANCE

- A. Materials: Use only materials furnished by a bulk bituminous concrete producer regularly engaged in the production of hot mixed, hot laid bituminous concrete.
- B. Equipment: Provide, maintain and operate pavers, dump trucks, tandem, 3-wheel and pneumatic tired rollers well suited to the mixtures being placed. Provide, maintain and operate hand equipment as required. When applicable, provide, maintain and operate trimming equipment and materials.
- C. General: All materials shall conform to the requirements of the State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges, and Incidental Construction, Form 816, latest edition (hereinafter referred to as CTDOT Specifications) and as specified herein.
- D. The purpose of this specification is to direct the Contractor's attention to certain paving items. Compliance with this specification does not relieve the Contractor of his obligation to perform his work in complete accordance with the Connecticut Department of Transportation's requirements.

1.3 SUBMITTALS

- A. A certificate of compliance shall be furnished to the Engineer that the materials supplied comply with the specification requirements.
- B. Delivery slips shall be furnished with each load of mix delivered to the project. Information shall include:
 - 1. Vehicle identification.
 - 2. Date.
 - 3. Project.
 - 4. Identification of material.
 - 5. Gross, tare and net weights.
 - 6. Signed by the bituminous concrete producer.
 - 7. Stamped by a licensed public weighmaster.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hot Bituminous Paving Mix - Roads, Parking Lots, Walkways and Driveways
 - 1. Temporary pavement shall consist of bituminous concrete paving, Class 1, conforming to CTDOT specification requirements. Refer to the Drawings for additional information.
 - 2. Permanent pavement shall consist of binder (base) and wearing (top) courses (Class 1 and Class 2) for bituminous concrete paving, conforming to CTDOT specification requirements. Refer to the Drawings for additional information.
 - 3. Tack coat shall consist of emulsified asphalt conforming to CTDOT specification requirements.
 - 4. Pavement marking paint shall be fast drying type conforming to CTDOT to specification requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. Grade Control:
 - 1. The Contractor shall establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.
- B. Reset all existing manholes and gate boxes, to finished grade as required at no additional cost to the Owner.

3.2 PAVEMENT REMOVAL

- A. General:
 - 1. Exercise extreme care in the removal of pavement so that pavement will not be unnecessarily disturbed or destroyed.
 - 2. Mechanically cut pavement to be removed to a straight line, unless otherwise directed by the Engineer.
 - 3. All pavement removed shall become the property of the Contractor and disposed of at acceptable locations. Town of Glastonbury will provide a local disposal site at no cost to the contractor for this material.
- B. Connecticut DOT Areas:
 - 1. When removing pavement under the jurisdiction of the Connecticut DOT, strictly adhere to all CTDOT regulations controlling pavement openings.

3.3 SURFACE PREPARATION

- A. Prime and Tack coats shall conform to the CTDOT Specifications.
- B. Tack Coat:
 - 1. Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.05 to 0.15 gallons per square yard of surface.

3.4 PLACING THE MIX

- A. General:

BITUMINOUS CONCRETE PAVING (CONNECTICUT)

1. Place asphalt concrete mixture on prepared surface. Minimum allowable temperature for placing is 250°F. Maximum shall be 32°5F. Place in areas inaccessible to paving machine and small areas by hand. Place each course to required grade, cross-slope and compacted thickness.
 2. Asphalt concrete shall only be placed when the base temperature is above 40°F for a minimum placement of 1½" or more of pavement or above 50°F for a minimum placement of less than 1½" of pavement.
- B. Protection:
1. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened to the extent that the pavement will not be damaged.

END OF SECTION

SECTION 02601MANHOLES, COVERS AND FRAMESPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Construct covers, frames, brick masonry, inverts and apply waterproofing in conformance with the dimensions, elevations, and locations shown on the Drawings and as specified herein.
- B. Related Work Specified Elsewhere (when applicable):
 - 1. Final sewer testing is specified in this Division.
 - 2. Pipe, excavation, backfill, paving and dewatering are specified in the appropriate Sections in this Division.
 - 3. Concrete and grout are specified in Division 3.

1.2 QUALITY ASSURANCE

- A. Frames and Covers:
 - 1. Acceptable Manufacturers:
 - a. EJ Castings
 - b. LeBaron Foundry Company.
 - c. Or equivalent.
- B. Masonry:
 - 1. Brick: Shall comply with the ASTM Standard Specifications for Sewer Brick (made from clay or shale), Designation C32, for Grade SS, hard brick.
 - 2. Cement: ASTM C-150.
 - 3. Hydrated Lime: ASTM C-207
 - 4. Sand: ASTM C144

1.3 SUBMITTALS TO THE ARCHITECT/ENGINEER

- A. Submit shop drawings and manufacturer's literature in conformance with Section 01340 and the Standard General Conditions of the Construction Contract.

PART 2 - PRODUCTS2.1 FRAMES AND COVERS

- A. Standard Units:
 - 1. Made of cast iron conforming to ASTM A48-76, Class 30 minimum.
 - 2. Have machined bearing surfaces to prevent rocking.
 - 3. Castings shall be smooth with no sharp edges.
 - 4. Constructed to support an HS-20 wheel loading.
 - 5. Dimensions and Style shall conform to the Drawings, Standard castings differing in non-essential details are subject to approval by the Engineer:
 - a. Covers -solid with sewer in 3-inch letters diamond pattern.
 - b. Frame - 24-inch diameter clear opening, with flange bracing ribs.
 - 6. Minimum weight of frame and cover shall be 370 lbs.

2.2 MASONRY

- A. Brick:
 - 1. Sound, hard, uniformly burned, regular and uniform in shape and size, compact texture, and satisfactory to the Engineer.
 - 2. Immediately remove rejected brick from the work.
- B. Mortar:
 - 1. Composition (by volume):
 - a. 1 part portland cement.
 - b. 1/2 part hydrated lime.
 - c. 4-1/2 parts sand.
 - 2. The proportion of cement to lime may vary from 1:1/4 for hard brick to 1:3/4 for softer brick, but in no case shall the volume of sand exceed 3 times the sum of the volume of cement and lime.
- C. Cement shall be Type II portland cement.
- D. Hydrated lime shall be Type S.
- E. Sand:
 - 1. Shall consist of inert natural sand.
 - 2. Grading:

<u>Sieve</u>	<u>Percent Passing</u>
No. 4	100
No. 8	95-100
No. 16	70-100
No. 30	40-75
No. 50	10-35
No. 100	2-15
No. 200	0-5

PART 3 - EXECUTION

3.1 PERFORMANCE

- A. Adjust to Grade:
 - 1. Adjust tops of manholes to grade with brick masonry.
 - 2. Concrete rings are not acceptable for adjusting to grade.
- B. Pipe Connections to Manholes: Connect pipes to manholes with joint design and materials approved by the Engineer.
- C. Masonry:
 - 1. Laying Brick:
 - a. Use only clean bricks in brickwork for manholes.
 - b. Moisten the brick by suitable means until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
 - c. Lay each brick in a full bed and joint of mortar without requiring subsequent grouting, flushing, or filling, and thoroughly bond as directed.
 - d. Construct all joints in a neat workmanlike manner. Construct the brick surfaces inside the manholes so they are smooth with no mortar extending beyond the bricks and no voids in the joints. Maximum mortar joints shall be 1/2 inch.

- e. Outside faces of brick masonry shall be plastered with mortar from 1/4-inch to 3/8-inch thick.
- f. Completed brickwork shall be watertight.
- 2. Curing:
 - a. Protect brick masonry from drying too rapidly by using burlaps which are kept moist, or by other approved means.
 - b. Protect brick masonry from the weather and frost as required.
- D. Frames and Covers:
 - 1. Set all frames in a full bed of mortar, true to grade and concentric with the manhole opening.
 - 2. Completely fill all voids beneath the bottom flange to make a watertight fit.
 - 3. Place a ring of mortar at least one inch thick around the outside of the bottom flange, extending to the outer edge of the manhole all around its circumference.
 - 4. Clean the frame seats before setting the covers in place.
- E. Cleaning:
 - 1. Thoroughly clean manholes, steps, frames and covers of all debris and foreign matter.

END OF SECTION

SECTION 02615DUCTILE IRON PIPE & FITTINGS
(BURIED APPLICATIONS)PART 1 - GENERAL1.1 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 the appropriate Section in this Division.
 - 2. Excavation, Bedding and Backfill are specified in this Division.
 - 3. Ductile Iron Pipe & Fittings for Interior Applications is specified in Section 15062.

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
 - 2. Griffin
 - 3. Union
 - 4. US Pipe
 - 5. Or equivalent.

1.3 DELIVERY, STORAGE & HANDLING

- A. Exercise extra care when handling ductile iron pipe because it is comparatively brittle.
- B. Exercise extra care when handling cement lined pipe because damage to the lining will render it unfit for use.
- C. Protect the spherical spigot ends and the plain ends of all pipe during shipment by wood lagging securely fastened in place.

PART 2 - PRODUCTS2.1 PIPE MATERIALS

- A. General:

1. All exterior (buried) ductile iron pipe shall have push-on or mechanical joints unless otherwise specified or shown on the Drawings. Pipe within valve pits and other structures is considered interior pipe and shall be flanged.
 2. Unless otherwise shown on the Drawings or in the pipe schedule, the minimum thickness of ductile iron pipe shall be:
 - a. For pipe 4 inches in diameter and smaller: Class 52.
 - b. Pipe with flanges: Class 53.
 3. Pipe for use with sleeve type couplings shall have plain ends (without bells or beads) cast or machined at right angles to the axis.
 4. 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.
 5. 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.
 6. Factory applied bituminous coatings (in accordance with AWWA C151) shall be furnished on the exterior of all underground piping unless specified otherwise.
 7. The outside of pipe within structures and exposed shall not be coated with bituminous coating, but shall be thoroughly cleaned and given one shop coat of Intertol Rustinhibitive Primer 621 by Koppers Co.; Multiprime by PPG Industries; Chromox 13R50 Primer made by Mobil Chemical Co.; or equivalent.
- B. Joints (as shown on Drawings or as specified):
1. Push-on and Mechanical Joint:
 - a. The plain ends of push-on pipes shall be factory machined to a true circle and chamfered to facilitate fitting the gasket.
 - b. Provide gaskets manufactured from a composition material suitable for exposure to the fluid to be contained within the pipe. On high temperature applications such as air lines, the gaskets shall be suitable for service from 40-Deg F to 250-Def F.
 - c. Bolts and nuts for buried mechanical joints shall meet the AWWA C-111 requirements and be made of high strength, low alloy steel.
 2. Flanged:
 - a. Provide specially drilled flanges when required for connection to existing piping or special equipment.
 - b. Flanges shall be long-hub screwed tightly on pipe by machine at the foundry prior to facing and drilling.
 - c. Gaskets:
 - i. Ring type of rubber with cloth insertion.
 - ii. Thickness of gaskets 12 inches in diameter and smaller: 1/16 inch.
 - iii. Thickness of gaskets larger than 12 inches in diameter: 3/32 inch.
 - iv. On high temperature applications such as air lines, the gaskets shall be suitable for service from 40°F to 200°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.
 - iv. After jointing, coat entire joint with bituminous material compatible with pipe coating unless other coating required by Section 09900.
 - e. When applicable, provide and install flange clamps as shown on the Drawings.
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. Mechanical joint follower gland pipe restrainers.
 - (1) Ductile iron gland and restraining ring.
 - (2) Gasket shall be standard MJ gasket -ANSI/AWWA-C111/A21.11.
 - (3) Working pressure 350 psi, up to 8 inches; 250 psi, 10 inches to 16 inches.
 - (4) Test pressure two times working pressure.
 - (5) Grip Rings™, Romac Industries, or other equivalent as approved by Engineer.
 - iii. Other types of bracing as shown on the Drawings.

2.2 FITTINGS

A. Standard Fittings:

- 1. Pressure rating of 350 psi for D.I. compact fittings and 250 psi for all others unless indicated otherwise on the Drawings or as specified.
- 2. Joints the same as the pipe with which they are used or as shown on the Drawings.
- 3. Cement lining and seal coat as specified for pipe.
- 4. Factory applied bituminous coatings shall be furnished for all underground fittings.

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. Concrete thrust blocks or other acceptable thrust resistant system is required at all fittings on pressure pipe. Where thrust blocks are used, these shall be placed against undisturbed soil or screened gravel compacted to 95 percent and shall be placed so that the joints are accessible for repairs.
- B. Assembling Joints:
 - 1. Push-on Joints:
 - a. Insert the gasket into the groove of the bell.
 - b. Uniformly apply a thin film of special lubricant over the inner surface of the gasket that will contact the spigot end of the pipe.
 - c. Insert the chamfered end of the plain pipe into the gasket and push until it seats against the bottom of the socket.
 - 2. 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. After jointing coat all bolts with bituminous material compatible with the pipe coating required herein and/or in Section 09900.
 - 3. 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.
 - 4. Mechanical Joints:
 - a. Thoroughly clean, with a wire brush, surfaces that will be in contact with the gaskets.
 - b. Lubricate the gasket, bell, and spigot by washing with soapy water.
 - c. Slip the gland and gasket, in that order, over the spigot and insert the spigot into the bell until properly seated.

- d. Evenly seat the gasket in the bell at all points, center the spigot, and firmly press the gland against the gasket.
 - e. Insert the bolts, install the nuts finger tight, and progressively tighten diametrically opposite nuts uniformly around the joint to the proper tension with a torque wrench.
 - f. The correct range of torque (as indicated by a torque wrench) and the length of wrench (if not a torque wrench) shall not exceed:
 - i. Range or Torque: 60-90 ft.-lbs.
 - ii. Length of Wrench: 10 inches.
 - g. If effective joint sealing is not attained at the maximum torque specified above, disassemble, thoroughly clean, and reassemble the joint. Do not overstress the bolts to tighten a leaking joint.
5. Bell and Spigot Joints:
- a. Thoroughly clean the bell and spigots and remove excess tar and other obstructions.
 - b. Insert the spigot firmly into place and hold securely until the joint has been properly completed.
- 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. Taps in fittings shall be located where indicated by the manufacturer for that particular type of fitting.
 - e. The maximum sizes of taps in pipes and fittings without busses shall not exceed the sizes listed in the appendix of ANS A21.51 based on 2 full threads for ductile iron and 3 full threads for cast iron.
 2. Cutting:
 - a. Perform all cutting as set forth in AWWA C600.
 - b. Carefully chamfer all cut ends to be used with push-on joints to prevent damage to gaskets when pipe is installed.
- D. Pipe Deflection:
1. Push-on and Mechanical Joints:
 - a. The maximum permissible deflection of alignment at joints shall be limited to that given in AWWA C600.
 2. Flexible Joints:
 - a. The maximum deflection in any direction shall not exceed the manufacturer's instructions and recommendations.

END OF SECTION

SECTION 02622POLYVINYL CHLORIDE (PVC) NON-PRESSURE PIPEPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included:
 - 1. Provide and install PVC non-pressure pipe and fittings of the size(s) and type(s) and in the location(s) shown on the Drawings and as specified herein.
- B. Related Work Specified Elsewhere: (When Applicable)
 - 1. Excavation and backfill, dewatering, pavement, borrow and bedding material, and cleaning and testing requirements are specified in the appropriate sections of this division.
 - 2. Pipe & Pipe Fittings - General is specified in Division 15.

1.2 QUALITY ASSURANCE

- A. Manufacturers:
 - 1. Certain-Teed.
 - 2. J-M Manufacturing.
 - 3. Or equivalent.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit shop drawings in accordance with the General Conditions of the Construction Contract.
- B. Submit manufacturer's "Certification of Conformance" that pipe and fittings meet or exceed the requirements of these Specifications.
- C. Submit other documents as specified in the appropriate Sections of this Division.

1.4 DELIVERY STORAGE AND HANDLING

- 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 area 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 tolerance for pipe clearances.
- E. All materials and methods not meeting the requirements of the Contract Documents will be rejected.
- F. Immediately remove all rejected materials from the project site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe and Fittings:

1. The polyvinyl chloride pipe and fittings, including those required for stubs, shall conform to ASTM standard specification for PVC Sewer Pipe and Fittings, Designation D 3034 (SDR 35) (4" to 15"), F679 (18" to 27"), or F1760-01 (for recycled pipe, all diameters).
2. Straight pipe shall be furnished in lengths of not more than 14 feet.
3. Saddles will not be allowed.

B. Joints:

1. Joints for the polyvinyl chloride pipe shall be push-on joints using factory installed elastomeric ring gaskets.
2. The gaskets shall be securely fixed into place by the manufacturer so that they cannot be dislodged during joint assembly.
3. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and ground water, and which will endure permanently under the conditions of the proposed use.
4. The joints shall conform to ASTM Specifications for Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals, Designation D3212-76.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspection:

1. Each pipe unit shall be inspected before being installed. No single piece of pipe shall be laid unless it is generally straight.
2. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16 inch per foot of length.
3. If a piece of pipe fails to meet this requirement for straightness it shall be rejected and removed from the site.
4. Any pipe unit or fitting discovered to be defective either before or after installation shall be removed and replaced with a sound unit.

B. Jointing:

1. All pipe and fittings shall be cleared of all debris, dirt, etc., before being installed and shall be kept clean until accepted in the completed work.
2. Pipe and fittings shall be installed to the lines and grades indicated on the drawings or as required by the Engineer. Care shall be taken to insure true alignments and gradients.
3. All joint surfaces shall be cleaned. Immediately before jointing the pipe, the bell or groove shall be lubricated in accordance with the manufacturer's recommendation.
4. Each pipe unit shall then be carefully pushed into place without damage to pipe or gasket. Suitable devices shall be used to force the pipe units together so that they will fit with a minimum open recess inside and outside and have tightly

sealed joints. Care shall be taken not to use such force as to wedge apart and split the bell or groove ends.

5. Joints shall not be "pulled" or "cramped" unless permitted by the Engineer.
- C. Service Connections:
1. All service connections to new pipe shall utilize a wye fitting.
 2. All service connections must enter the top half of the mainline pipe.
- D. Pipe Deflection:
1. Pipe provided under this specification shall be installed so there is no more than a maximum deflection of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (normal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.
 2. The Contractor shall wait a minimum of 30 days after completion of a section of sewer, including placement and compaction of backfill, before measuring the amount of deflection by pulling a specially designed gage assembly through the completed section. The gage assembly shall be in accordance with the recommendations of the pipe manufacturer and be acceptable to the Engineer.
 3. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem as the Engineer may require without additional compensation.
- E. Testing:
1. Clean and test pipe in accordance with appropriate sections of this division.

END OF SECTION

SECTION 02641GATE VALVESPART 1 - GENERAL1.1 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:
 - 1. "Valve Box" and "Ductile Iron Pipe & Fittings for Buried Applications" are specified in this Division.
 - 2. "Valves and Specialties - General" is specified in Division 15.

1.2 QUALITY ASSURANCE

- A. All gate valves of same type and style shall be manufactured by one manufacturer.
- B. Acceptable Manufacturers:
 - 1. American Flow Control
 - 2. Kennedy
 - 3. Darling
 - 4. Mueller
 - 5. Or approved equal.

PART 2 - PRODUCTS2.1 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 Nitrile elastomer 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
 - 6. Bolting - stainless steel Type 18-8, ASTM F593, GP1
 - 7. End Connections
 - a. Buried valves - mechanical joints
 - 8. Operation
 - a. Buried valves - 2 inch square nut, cast iron, ASTM A126, C1B
 - b. Opening Direction - counterclockwise
 - 9. Water working pressure: 250 psi
 - 10. Standards - valves shall meet or exceed AWWA C509, latest edition.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install valves with stem position vertical.
- B. Valve box vertical and centered over operating nut.
- C. Valve box supported during backfilling and maintained vertical.
- D. Install and test in accordance with AWWA C500 and AWWA C-509, latest revision.
- E. For PVC or PE main, install anchor rods around the valve body or through the mounting lugs and embed the rods in concrete beneath the valve.

END OF SECTION

SECTION 02646VALVE BOXESPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish and install valve boxes of type(s) and size(s) and in the locations shown on the Drawings and as specified herein.

1.2 QUALITY ASSURANCE

- A. All valve boxes shall be manufactured by one manufacturer.
- B. Qualifications of Manufacturer: Products to have been proven reliable in similar installations over a reasonable number of years.
- C. Acceptable Manufacturers:
 - 1. Mueller
 - 2. Quality Water Products
 - 3. Or Equivalent

PART 2 - PRODUCTS2.1 MATERIALS

- A. The valve box shall be ductile iron, slip type two-piece integral base, 5-1/4 inch shaft. Top section with flanges.
- B. Cast or Ductile iron, with the word "Sewer" cast in covers.
- C. Belled Base Section.

PART 3 - EXECUTION3.1 INSTALLATION

- A. Installation as shown on the Drawings and/or as specified herein.
 - 1. When installation is complete, no pressure shall be exerted by valve box on the water main or on the valve.
 - 2. Be of such length as required without full extension. Minimum lap 6 inches.

END OF SECTION

SECTION 02650BURIED UTILITY MARKINGSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included:
1. This work shall consist of providing and installing utility line markings above all buried lines installed as part of this contract and replacing existing markings disturbed as part of this contract. Buried utilities are indicated on the Civil and Electrical Drawings.
- B. Related Work Specified Elsewhere:
1. Pipe, excavation, backfill, insulation are specified in the appropriate Sections in this Division.

PART 2 - PRODUCTS2.1 MATERIALS

- A. Materials and color shall be in accordance with latest AASHTO specifications for pipe and utility marking.
- B. Marking tape color shall be in accordance with latest American Public Works Association (APWA) Uniform Color Code and American National Standards Institute ANSI Standard Z535.1, Safety Color Code specifications for buried utility marking as noted in the Schedule below.
1. Schedule

Marker Color	Buried Utility
Blue	Potable Water & Associated lines
Green	Sanitary Sewers, Storm Drain and other Drain lines
Orange	Telecommunication, signal, alarm
Purple	Reclaimed, Recycled, Irrigation Water and Slurry Lines
Red	Electric Power lines cables conduits and lighting cables
Yellow	Gas, Oil, Steam, Petroleum or Gaseous Material Lines

2. Warning Information shall be in Black Letters with typical wording of:
 - a. "CAUTION: BURIED (NAME OF UTILITY LINE) BELOW"
- C. For ferrous pipe material use 0.004" minimum polyethylene film; 6" wide clearly marking type of buried utility.
- D. For non-ferrous pipe material (e.g. Concrete, PVC, PE, etc.) use detection tape composite of polyethylene and metallic core 6" wide clearly marking type of buried utility.
- E. Seton Identification Products, New Haven, CT, Utility Safeguard LLC or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Marking tape shall be installed over utility lines centerline and buried 24" below grade.
- B. Markings damaged during opening of trench shall be reinstalled with 2' overlap at broken sections.

END OF SECTION

SECTION 02655COUPLINGS & CONNECTORS FOR BURIED APPLICATIONSPART 1 - GENERAL1.1 DESCRIPTION

- A. Furnish and install couplings and connectors of the type and size in the location shown on the Drawings and as specified herein.

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 - PRODUCTS2.1 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 Transition Couplings
 - 1. Buried Couplings:
 - a. Ductile iron center sleeve and end rings made per ASTM A536, Grade 65-45-12
 - b. Two wedge-section virgin SBR rubber gaskets compounded for water service,
 - c. Nuts and bolts shall be ductile iron low alloy steel per ANSI/AWWA A21.11/C-111.
 - d. Couplings shall be long barrel type.
 - e. Coupling shall be fusion bonded epoxy coated meeting NSF 61 standards for potable water applications
 - f. Acceptable Manufacturers:
 - i. Romac Industries Model 501
 - ii. Ford style FC1 and FC2A
 - iii. Smith Blair
 - iv. Or Equal
- C. Solid Sleeve Couplings
 - 1. Solid sleeves shall be ductile iron with mechanical joint ends.
 - 2. Couplings shall meet AWWA/ANSI C-153/A21.53 and C-111/A21.11 for joints, and C-104/A21.4 for cement lining in sizes 3"-24".
 - 3. Nuts and bolts shall be ductile iron low alloy steel per ANSI/AWWA A21.11/C-
- D. Flexible Couplings for drain connections
 - 1. Rubber material with stainless steel clamps

COUPLINGS & CONNECTORS FOR BURIED APPLICATIONS

2. Must provide a positive seal against infiltration and exfiltration
 3. Coupling materials must conform to ASTM C443, C564, and D1869.
- E. Mechanical Joint Adaptors (Foster Adaptor®)
1. Required to connect fittings and valves with mechanical joints
 2. Ductile iron construction mechanical joint bolt pattern.
 3. Bolts and nuts shall meet AWWA C-111.

PART 3 - EXECUTION3.1 INSTALLATION

- A. Sleeve Type Couplings:
1. Thoroughly clean pipe ends a minimum of 12-inches from the ends prior to installing couplings, and use soapy water as a gasket lubricant.
 2. Slip an end ring and gasket over each pipe and place the center sleeve centered over the joint.
 3. Insert the other pipe length into the center sleeve the proper distance.
 4. Press the gaskets and end rings evenly and firmly into the center sleeve 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.
- B. Install thrust rods, supports, and other provisions to properly support pipe weight and axial equipment loads.

END OF SECTION

SECTION 02755FINAL SEWER TESTINGPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. Final sewer testing work includes the performance of testing and inspecting each and every length of sewer pipe, pipe joints and each item of appurtenant construction.
2. Perform testing at a time acceptable to the Engineer, which may be during the construction operations, after completion of a substantial and convenient section of the work, or after the completion of all pipe laying operations.
3. Provide all labor, pumps, pipe, connections, gages, measuring devices and all other necessary apparatus to conduct tests.

B. Related Work Specified Elsewhere (When Applicable):

1. Excavation, backfill, dewatering, pipe, pipe fittings and manholes are specified in the appropriate Sections in this Division and/or Division 15.
2. Manhole testing is specified in Section 02601 - Manholes, Covers and Frames.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION3.1 PERFORMANCE

A. General:

1. All sewers, manholes, and appurtenant work, in order to be eligible for acceptance by the Engineer, shall be subjected to tests that will determine the degree of watertightness and horizontal and vertical alignment.
2. Thoroughly clean and/or flush all sewer lines to be tested, in a manner and to the extent acceptable to the Engineer, prior to initiating test procedures.
3. Perform all tests and inspections in the presence of the Engineer and the plumbing or building inspector in accordance with the requirements of the local and state plumbing codes.
4. Perform testing by test patterns determined by or acceptable to the Engineer.
5. Remedial Work:
 - a. Perform all work necessary to correct deficiencies discovered as a result of testing and/or inspections.
 - b. Completely retest all portions of the original construction on which remedial work has been performed.
 - c. Perform all remedial work and retesting in a manner and at a time acceptable to by the Engineer at no additional cost to the Owner.

B. Line Acceptance Tests (Gravity sewers with no active service connections):

1. Test all gravity sewer lines with no active service connections for leakage by conducting a low pressure air test.
2. Equipment:
 - a. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
 - b. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
 - c. All air used shall pass through a single central panel.
 - d. Connect 3 individual hoses:
 - i. From the control panel to the pneumatic plugs for inflation.
 - ii. From the control panel to the sealed sewer line for introducing the low pressure air.
 - iii. From the sealed sewer line to the control panel for continually monitoring the air pressure rise in the sealed line.
3. Testing Pneumatic Plugs:
 - a. Seal test all pneumatic plugs prior to using them in the actual test.
 - b. Lay one length of pipe on the ground and seal both ends with the pneumatic plugs to be tested.
 - c. Pressurize the sealed pipe to 5 psig.
 - d. The pneumatic plugs are acceptable if they remain in place without bracing.
4. Testing Sewer Pipeline:
 - a. After the sewer pipe has been cleaned and the pneumatic plugs checked, place the plugs in the sewer line at each manhole and inflate them.
 - b. Introduce low pressure air into the sealed sewer pipeline until the air pressure reaches 4 psig greater than the average groundwater pressure.
 - c. Allow a minimum of 2 minutes for the air pressure to stabilize to a minimum of 3.5 psig greater than the groundwater pressure. Groundwater is assumed to be at ground surface unless the Contractor can prove by otherwise by test pitting.
 - d. After the stabilization period, disconnect the air hose from the control panel to the air supply.
 - e. The pipeline will be acceptable if the pressure decrease is not greater than 1/2 psig in the time stated in the following table for the length of pipe being tested:

<u>Pipe Diameter</u> (inches)	<u>Time (Min.) for Length of Pipe</u>			
	<u>0-100 ft</u>	<u>101-200 ft</u>	<u>201-300 ft</u>	<u>301-400 ft</u>
4	2.0	2.0	2.0	2.0
6	3.0	3.0	3.0	3.0
8	4.0	4.0	4.0	5.0
10	5.0	5.0	6.0	8.0
12	5.5	5.5	8.5	11.5
15	7.0	8.5	13.0	17.0

<u>Pipe Diameter</u> (inches)	<u>Time (Min.) for Length of Pipe</u>			
	<u>0-100 ft</u>	<u>101-200 ft</u>	<u>201-300 ft</u>	<u>301-400 ft</u>
18	8.5	12.0	19.0	25.0
21	10.0	17.5	26.0	35.0
24	11.5	23.0	34.0	45.5
27 and larger	14.5	29	43.0	58.0

5. Test Results:
 - a. If the installation fails the low pressure air test, determine the source of leakage.
 - b. Repair or replace all defective materials and/or workmanship and repeat low pressure air test at no additional cost to the Owner.
- C. Line Acceptance Tests (Gravity sewers with active services):
 1. Test all new gravity sewer lines with active services by conducting a low-pressure air test on all joints using a packer after all services have been connected or capped at the property line and all trenches backfilled but before the surface course of permanent pavement is installed.
 2. Equipment:
 - a. Closed-circuit television system.
 - b. Testing devices (packer):
 - i. Capable of isolating individual joints by creating a sealed void space around the joint being tested.
 - ii. Constructed such that low pressure air can be admitted into the void area.
 - iii. Shall contain a pressure gauge accurate to one tenth (0.1) psi in-line with the feed line to monitor the void pressure.
 - iv. Capable of performing in sewer lines where flows do not exceed 1/4 of the pipe diameter without resorting to any method of flow control.
 3. Testing Sewer Pipeline Joints:
 - a. Test all joints except those with visible infiltration.
 - b. Procedure:
 - i. Pull television camera through sewer line in front of the packer.
 - ii. Position the packer on each joint to be tested.
 - iii. Inflate the sleeves on each end of the packer.
 - iv. Apply four (4.0) psi pressure above the existing hydrostatic pressure on the outside of the joint to the void area created around the inside perimeter of the joint.
 - v. Shut off the supply of air once the pressure has stabilized at the required amount.
 - vi. Monitor the void pressure for thirty (30) seconds.
 - vii. Repair the joint if the pressure drops more than one half (1/2) psi in the thirty (30) seconds.

- c. Water or chemical pressure testing may be used in lieu of air testing subject to review and approval by the Engineer.
 - d. Re-clean and re-inspect all lines not approved by the Engineer at no additional cost to the Owner.
 - e. Repairing of Joints:
 - i. When a joint fails the pressure test, excavate and repair the failed joint. Repairing joints with chemical grout will not be permitted.
 - f. The Engineer may request checking of the testing equipment for accuracy.
 - i. Perform standard air test on a clean continuous section of pipe.
 - ii. Repair the equipment if the void pressure drops.
 - g. Testing Operation Inspection:
 - i. Reset each joint, as specified herein, prior to acceptance and final payment for joint testing. Retest all joints that fail until the test requirements are met.
 - h. The contractor will supply a black and white photograph of every joint that fails the pressure test.
- D. Alignment Tests (Gravity Sewers):
- 1. Perform tests for the correctness of horizontal and vertical alignment on each and every length of gravity sewer pipeline between manholes.
 - 2. Alignment tests to be conducted after all pipe has been installed and backfilled.
 - 3. The observation test shall be conducted after all upstream work has been completed and the pipeline cleaned of debris.
 - 4. Notify the Engineer at least 24 hours in advance of the proposed observation testing.
 - 5. Introduce water into the sewer lines to be tested from the upstream manhole prior to the observation test but no more than 24 hours in advance of the test.
 - 6. Beam a source of light, acceptable to the Engineer, through the pipeline from both ends and the Engineer will directly observe the light in the downstream, and/or upstream manhole of each test section.
 - 7. The length of pipe between manholes, diameter of pipe and amount of light observed in the manhole at the end of each pipe section will determine acceptance of the alignment test by the Engineer.
 - 8. The amount of vertical and horizontal deflection shall not be greater than the ASTM allowance and (manufacturer's recommendations) for the pipe being tested.
 - 9. No standing water shall be allowed. The presence of standing water shall be cause for rejection of that pipe (including manhole) section.
 - 10. Improper alignment will be corrected by re-excavation and resetting of pipe at no additional cost to the Owner.
- E. Pipe Deflection: (Gravity Sewers)
- 1. Pipe provided under this specification shall be installed so there is no more than a maximum deflection of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (normal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.
 - 2. The Contractor shall wait a minimum of 30 days after completion of a section of sewer, including placement and compaction of backfill, before measuring the

- amount of deflection by pulling a specially designed gage assembly through the completed section. The gage assembly shall be in accordance with the recommendations of the pipe manufacturer and be acceptable to the Engineer.
3. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem as the Engineer may require without additional compensation.
- F. Television Inspection Tests (Gravity Sewers)
1. Where television inspection testing is required, test procedures shall be in compliance with the requirements outlined in Specification Section 02753.
 2. No standing water shall be allowed. The presence of standing water may be cause for rejection of that pipe.
 3. Any standing water, detectable leaks, improper joints or any other unacceptable feature detected by the television inspection will be corrected by re-excavation and resetting pipe at no additional cost to the Owner.
- G. Inspection of Appurtenant Installations:
1. Completely inspect, at a time determined by the Engineer, all manholes and inlets to ascertain their compliance with the Drawings and Specifications.
 2. Provide access to each manhole and inlet and check the following characteristics:
 - a. Shape and finish of invert channels,
 - b. Watertightness and finish of masonry structures,
 - c. Location, type, and attachment of stops,
 - d. Elevation and attachment of frames, covers, and openings,
 - e. Pattern and machining of covers, and
 - f. Drop connection arrangements.
- H. Testing Pressure Sewers:
1. 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.
 2. 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.
 3. Perform pressure and leakage test at 1-½ times the maximum system pressure or 100 psi which ever is greater (based on the elevation of the lowest point of the section under test and corrected to the gage location).
 4. 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 exceeds a rate of 10 gallons per inch of diameter per 24 hours per mile of pipeline the section shall be considered as having failed the test. All joints within chambers and all flanged joints shall have no visible leakage.
 5. 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 his 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.

- I. Manhole Leakage Testing:
 1. Specified in the "Manholes, Covers and Frames" Section in Division 2.

END OF SECTION

SECTION 02832

PRECAST CONCRETE MODULAR BLOCK RETAINING WALL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work includes design, furnishing and installing concrete modular block retaining wall units to the lines and grades as shown on the Drawings and as specified herein.
- B. Work includes preparing foundation, soil, furnishing and installing leveling pad, unit fill and backfill to the lines and grades shown on the Drawings.
- C. Work includes furnishing and installing all related materials for the construction of the retaining wall.

1.2 SECTION INCLUDES

- A. Precast Concrete Modular Block Retaining Wall
- B. Geosynthetic Reinforcement Fabric
- C. Adhesives

1.3 RELATED SECTIONS

- A. Section 01340 - Submittals
- B. Section 02200 - Earthwork

1.4 REFERENCES

- A. ASTM C260-00 - Specification for Air Entraining Admixtures for Concrete
- B. ASTM C494/C494M-99a - Specification for Chemical Admixtures for Concrete
- C. ASTM C1372-04 - Specification for Segmental Retaining Wall Units
- D. ASTM C4595-05 - Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
- E. ASTM D4632-91(2003) - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- F. ASTM D5262-06 - Standard Test Method for Evaluating the Unconfined Tension Creep Rupture Behavior of Geosynthetics
- G. ASTM D6638-06 - Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)
- H. NCMA "Design Manual for Segmental Retaining Walls"

1.5 DESIGN REQUIREMENTS

- A. The precast concrete wall units shall be designed in accordance with the NCMA "Design Manual for Segmental Retaining Walls"
- B. The precast concrete shall support its own weight plus the following minimum superimposed loads:
 - 1. Lateral earth pressures:

PRECAST CONCRETE MODULAR BLOCK RETAINING WALL

- a. Lateral earth pressures from a 300 psf applied surcharge.
 - b. Lateral earth pressure assuming Coulumb Active Earth Pressure Coefficient using the following
 - i. $\phi = 30$ degrees
 - ii Soil unit weight = 125 pcf
 2. Retaining walls shall be sized so as not to exceed a soil bearing capacity of 2,000 psf.
 3. H-20 Vehicular Loading Surcharge.
- C. Performance Criteria:
1. Provide installation of a wall system to achieve the locations and grades depicted on the design plans and local field conditions.
 2. Provide submittals as outlined in paragraph 1.6.
 3. Installation of the wall shall be performed in accordance with OSHA trenching and shoring regulations.

1.6 SUBMITTALS

A. Manufacturer's Data:

1. Submit manufacturer's specifications and installation instructions for all manufactured materials and products.
2. Contractor shall submit the proposed erection procedure for precast units, sequence of erection, and required handling equipment.

B. Shop Drawings:

1. Submit design calculations prepared in accordance with the NCMA Design Manual for Segmental Retaining Walls. Calculations and Drawings shall be prepared and stamped by a Professional Engineer registered in the State of Connecticut, and has prior experience with such walls.
2. Wall design submittal shall include calculations and analyses to evaluate internal stability and global stability of the wall system in relation to the site specific proposed grading.
3. Submit shop drawings showing complete information for the fabrication and installation of precast concrete units, including wall heights, geofabric layout, and drainage provisions.
4. Submit member dimensions and cross section, location, size, type and details of reinforcement, including special reinforcement and lifting devices necessary for handling and erection, joints.
5. Submit layout, dimensions, and identification of each precast unit corresponding to the sequence and procedure of installation.
6. Submit manufacturer's literature and test data for geogrids to be used in the segmental wall system. Test data shall include connection strength data in accordance with ASTM D6638, geogrid tensile strength in accordance with ASTM D4595 and geogrid creep in accordance with ASTM D5262.
7. Submit samples for block, ties, and geofabric, and all other products.

1.7 QUALITY ASSURANCE

- A. The manufacturer shall exhibit satisfactory performance on projects of similar magnitude under similar or equal service conditions for a period of not less than 5 years. Submit past job list with Owner contact information.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Contractor shall protect all materials from damage. All damaged materials shall be immediately removed from the project site and not incorporated into the finished wall system.
- B. Contractor shall prevent excessive mud, concrete, adhesives and other substance that may adhere to or come in contact with the system components.
- C. Exposed faces of precast segmental units shall be reasonably free of chips, cracks or stains.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Redi-Rock Retaining Wall System
- B. Keystone Retaining Wall Systems Inc., Minneapolis, MN
- C. Versa-Lok Retaining Wall Systems, Oakdale, MN
- D. Or Equivalent

2.2 MATERIALS

- A. Precast Concrete Segmental Wall Units
 1. All precast units shall conform to ASTM C1372.
 2. Minimum unit depth shall be 28 inches.
 3. Minimum unit height shall be 18 inches.
 4. Units shall be positively interlocked.
 5. Color and face pattern shall be as selected by the Owner.
 6. Maximum water absorption shall be 8%.
 7. Minimum compressive strength of concrete 4,000 psi at 28 days.
 8. Cement for all units shall be Type I or II Portland cement conforming to ASTM C150.
 9. Concrete shall be air entrained at $6\% \pm 1\%$.
 10. All voids between and within the blocks shall be filled with crushed stone fill.
- B. Geogrid
 1. Grids shall consist of high molecular weight, high tenacity multifilament polyester yarns woven into a stable network placed under tension.
 2. Polyester yarns shall be coated with PVC material.
 3. Geogrids shall be inert to biological degradation and resistant to naturally occurring chemicals, alkalis and acids.
 4. Install in accordance with manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Proof roll the subgrade with a single drum vibratory roller less than 5 feet in width with a static weight of at least 3 tons. Place the bottom course of units directly on the fill base as indicated on the Drawings. Check units for level and alignment.
- B. Fill all voids between and within the blocks with crushed stone fill. The fill shall extend a minimum of 12 inches beyond the tails behind the facing units.
- C. Place fill behind the units as indicated on the Drawings. Fill shall be placed in maximum 8-inch lifts and compacted to 95% of its maximum dry density.
- D. Compact reinforced soil fill to 98 percent maximum dry density.
- E. Place cap units and secure with cap adhesive.
- F. Use only hand operated compaction equipment within 36-inches of wall.
- G. Remove excessive fill from the top of the units before placing the next course.
- H. For walls reinforced with geogrids, place the geogrids horizontally atop compacted backfill prior to installing subsequent layers. Extend the geogrid onto the front face flange of the facing unit. The geogrid shall be placed with the strong axis (machine direction) placed perpendicular to the wall face. Geogrid shall not be spliced by any means in the roll direction
- I. Geogrids shall be placed side by side to provide complete coverage along the wall face. No overlap is required between adjacent sections on straight walls. On curved walls, place a minimum of 3 inches of fill material between overlapping layers. Pull geogrids taught and stake the loose end before placing the next course of fill. Place and compact the fill in a manner that minimizes the development of wrinkles and movement in the geogrid. Place a minimum depth of 6 inches of fill before operating equipment over the geogrid.
- J. Place the next course of units in running bond with the previous course. Place the web notch over the alignment hoop protruding from the unit below, and pull the unit forward to contact the hoop.
- K. Continue placing subsequent courses to the elevation shown on the Drawings.
- L. Provide filter fabric barrier (multiple layers) at locations where the retaining wall abuts the Process Building foundation to prevent Structural Fill backfill material from seeping through the adjoining crack.

3.2 CLEANING, REPAIRING AND PROTECTION

- A. After erection is complete, any chipped or damaged units and any depressions left by removal of lifting devices shall be properly repaired by the erector. Also, all erection dirt incurred during the erection process shall be removed.

END OF SECTION

SECTION 03300CAST-IN-PLACE CONCRETEPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Cast-In-Place Concrete
- B. Formwork
- C. Concrete reinforcement and accessories
- D. Modifications and/or Repairs to concrete
- E. Concrete curing
- F. Concrete finishing
- G. Concrete testing
- H. Non-Shrink Grout

1.2 PRODUCTS INSTALLED BUT FURNISHED UNDER OTHER SECTIONS

- A. Conduit - Division 16

1.3 RELATED SECTIONS

- A. Section 01340 - Submittals
- B. Section 01400 - Quality Control
- C. Section 05500 - Metal Fabrications
- D. Section 07210 - Building Insulation
- E. Section 07900 - Joint Sealers
- F. Section 16050 - Basic Materials and Methods

1.4 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. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.
- B. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials
- C. ACI 301 - Specifications for Structural Concrete
- D. ACI 306.1 - Specification for Cold Weather Concreting
- E. ACI 306R – Guide to Cold Weather Concreting
- F. ACI 355.4 – Qualifications of Post-Installed Adhesive Anchors in Concrete
- G. ACI SP-66 – ACI Detailing Manual
- H. ASTM A615/A615M - Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement

- I. ASTM A1064/A1064M – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain or Deformed, for Concrete
- J. ASTM C33 - Specification for Concrete Aggregates
- K. ASTM C40 – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
- L. ASTM C88 – Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- M. ASTM C94/C94M - Specification for Ready Mixed Concrete
- N. ASTM C131/C131M – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Abrasion Machine
- O. ASTM C150 - Specification for Portland Cement
- P. ASTM C260 - Specification for Air Entraining Admixtures for Concrete
- Q. ASTM C309 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- R. ASTM C494/C494M - Specification for Chemical Admixtures for Concrete
- S. ASTM C535 – Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Abrasion Machine
- T. ASTM C595/C595M - Specification for Blended Hydraulic Cements
- U. ASTM C618 - Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- V. ASTM C827 - Test Method for Changes in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
- W. ASTM C989 - Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
- X. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
- Y. ASTM C1107/C1107M - Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- Z. ASTM C1260 – Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
- AA. ASTM C1293 – Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
- BB. ASTM C1567 – Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar Bar Method)
- CC. ASTM E329 – Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
- DD. AWS D1.4/D1.4M – Structural Welding Code – Reinforcing Steel
- EE. Concrete Reinforcing Steel Institute – 10MSP, Manual of Standard Practice
- FF. Concrete Reinforcing Steel Institute - Placing Reinforcing Bars
- GG. CRD-C621 - Specification for Non-Shrink Grout
- HH. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301, ACI 117 and ACI 306.1 as modified herein.
- B. Non-shrink grout shall conform to Army Corps of Engineers Specification CRD-C621 and ASTM C1107 (Grades B or C).
- C. Non-shrink grout shall exhibit non-shrink characteristics when tested according to ASTM C827.
- D. Expansion and epoxy anchors shall meet the following requirements:
 - 1. Expansion anchors shall be qualified for earthquake loading (use in cracked concrete) in accordance with ACI 355.2. Epoxy anchors shall be qualified for earthquake loading (use in cracked concrete) in accordance with ACI 355.4.

1.6 QUALIFICATIONS OF INDEPENDENT TESTING LABORATORY

- A. Independent Testing Laboratory shall conform to concrete testing requirements of ASTM C1077 and ASTM E329.
- B. Key personnel must be qualified and experienced in concrete quality assurance.
- C. Perform concrete field quality control testing with personnel certified as an ACI Concrete Field Testing Technician, Grade 1 according to the American Concrete Institute (ACI).

1.7 SUBMITTALS

- A. Submit shop drawings for concrete reinforcement prior to fabrication, showing bar bends, details and placement and certified copies of Mill Test Reports for the reinforcing steel materials analysis. Conform to ACI SP-66. Details shall include:
 - 1. Sizes, dimensions, and locations for reinforcement and supports
 - 2. Bending diagrams and schedules
 - 3. Splices
 - 4. Cover and clearances
 - 5. Class designation and details for bar supports
 - 6. Pertinent reinforced concrete details with dimensions and elevations
 - 7. Embedded items furnished by other trades and/or under other sections of the specification that are to be cast in concrete where interference with reinforcing steel bars may occur
 - 8. Show reinforcement on: Plan views of slabs, wall elevations and sections. Provide plan details at wall intersections and openings.
- B. Submit Concrete Mix designs including field performance test results which meet the criteria specified in ACI 301, Section 4. Mix design shall include:
 - 1. Proportions for all ingredients, 28-day design compressive strength, water to cementitious materials ratio, admixture dosages, slump, and air content.
 - 2. Cement Manufacturer's Certificates of conformance with ASTM C150 taken during the last 90 days.
 - 3. Supplementary Cementitious Materials: Source and test reports with certificates of conformance with ASTM C618 for fly ash and ASTM C989 for ground granulated blast furnace slag for actual material to be used in the Work taken during the last 90 days

4. Aggregate: data not older than 90 days, except test data for soundness, abrasion, alkali reactivity – not older than 12 months. Fine and coarse aggregate data shall include:
 - a. Sources
 - b. Specific Gravity
 - c. Sieve analyses per ASTM C33/C33M, including fineness modulus of fine aggregate
 - d. Organic impurities for fine aggregate per ASTM C40
 - e. Potential alkali reactivity (except not required if a cement containing less than 0.60% alkalis is used, per ASTM C33/C33M), per ASTM C1260, ASTM C1293, or ASTM C1567
 - f. Soundness per ASTM C88
 - g. Abrasion for coarse aggregate per ASTM C131/C131M and ASTM C535
5. Product data and material safety data sheets for concrete admixtures.
6. Test reports by testing agencies meeting ASTM E329:
 - a. Field test data used to determine the standard deviation used for establishing the required average design strength, and field test data documenting that the proposed concrete proportions will produce an average compressive strength equal or greater than the required average compressive strength, shall be from within the previous 12 months.
 - b. Laboratory trial batch data shall be from within the previous 24 months.
- C. Submit product data and material safety data sheets for concrete accessories.
- D. Submit sample concrete mix delivery slip that shall include the following information:
 1. Serial number of ticket
 2. Date and project location
 3. Name and location of ready mixed concrete plant
 4. Truck number, time loaded, cubic yards delivered
 5. Mixture design
 6. Quantities of admixtures, with brand names
 7. Quantities and types of cement, fly ash and/or slag
 8. Quantity of water including quantity of water withheld
 9. Quantities of fine and coarse aggregate including moisture content, nominal maximum aggregate size
 10. Quantity of water added subsequent to plant batching
 11. Unloading time and location
- E. Submit product data and material safety data sheets for form release agent.
- F. Submit product data for epoxy adhesive anchors. Data shall include:
 1. Material properties of anchors and epoxy adhesive
 2. ICC-ES AC308 report
 3. Allowable and ultimate loads of the anchor system
 4. Storage requirements
 5. Installation requirements including:
 - a. Drilling method (diamond drill bit shall be prohibited)
 - b. Drill bit diameter and depth of hole for each size anchor
 - c. Hole cleaning procedure and required condition of hole

- d. Requirements for discarding initial discharge to ensure proper mixing
 - e. Hole filling procedure
 - f. Time period when anchor cannot be contacted or otherwise disturbed
 - g. Gel and cure times as a function of temperature
 - h. Installation temperature requirements for cartridges and base material
 - G. Submit product data for form ties.
 - H. Submit a conduit layout plan under the appropriate sections of Division 16 prior to submitting reinforcing steel shop drawings.
 - I. Submit methods to be used to protect the concrete during cold weather placements and curing periods. The Engineer's review shall be for information only as the Contractor is responsible for the means and methods of protection of concrete placed during cold weather.
 - J. Submit methods to be used to protect the concrete during hot weather placements and curing periods. The Engineer's review shall be for information only as the Contractor is responsible for the means and methods of protection of concrete placed during hot weather.
 - K. Submit product data and material safety data sheets for curing compounds and floor hardeners. Indicate the intended use and location for all products.
 - L. Submit product data and material safety data sheets for repair materials. Indicate the intended use and location for all products.
 - M. Submit curing methods.
 - N. Submit product data and manufacturer's installation instructions for non-shrink grout.
- 1.8 DELIVERY, STORAGE AND HANDLING (NON-SHRINK GROUT)
- A. Deliver in original sealed packages or containers, labeled with the manufacturer's identification, printed instructions and batch code.
 - B. Store in dry conditions above freezing and below 90°F.
 - C. Keep unused portions of opened containers dry and warm.
 - D. Store aggregate covered and protected from the elements.
- 1.9 ENVIRONMENTAL CONDITIONS (NON-SHRINK GROUT)
- A. Do not place grout when exposed to precipitation.
 - B. Place grout when temperature of substrate and ambient air are above 40°F and below 90°F.
 - C. Place grout outside these limits when approved by heating substrates, enclosing work, shading, cooling or other measure to mitigate adverse weather conditions.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Undamaged smooth form facing materials such as plywood, hardboard, metal and plastic that will produce a smooth form finish with fins and offsets not exceeding 1/8 inch. Surfaces shall be clean, free of scratches, mars and discolorations.
- B. Steel: Minimum 16 ga. sheet, well matched, tight fitting, stiffened to resist loads without excess deflection.
- C. Aluminum: Forms with unoxidized surfaces shall be pretreated with a calcium

hydroxide and water paste followed by repeated water rinsing until hydrogen bubbles no longer form.

- D. Chamfer Corners: Chamfer, Wood Strip Type; $\frac{3}{4}$ " x $\frac{3}{4}$ " minimum, maximum possible length.
- E. Form Ties: Snap-off type, galvanized metal, adjustable lengths designed to break back at least 1 inch from finished surface or ties as indicated above.
- F. Form release agent: Non-staining colorless, compatible with finishes.
 - 1. Super-X Emulsive by A.H. Harris & Sons, Inc., or equivalent
 - 2. StarSeal EF Bio-Release by Vexcon
 - 3. Q-2 Form Release by Unitex
 - 4. Seacord RA II by Concord Chemical, Farm Fresh by Unitex

2.2 REINFORCING STEEL

- A. "Reinforcing Steel" shall include all bars, anchorages, stirrups, dowels, ties, tie-wire, chairs and other steel supports, and spacers, as noted on the Contract Drawings, specified herein, and as required for the proper completion of the Work.
- B. Bars: ASTM A615 Grade 60; deformed new materials. Cold-bent in accordance with CRSI 10MSP
- C. Tie wire: ASTM A1064/A1064M, annealed.
- D. Bolsters, chairs, spacers and other supports to properly position reinforcement shall conform to the "Bar Support" recommendations of CRSI 10MSP, and shall be of adequate strength and design to prevent displacement of reinforcement and discoloration of concrete. Where concrete surfaces are exposed to view, weather and/or moisture supports shall be Class 1 Plastic, Plastic Protected, or epoxy-coated. Supports for bottom reinforcement for slabs placed on soil or on a mud mat with no more than 3 inches of cover shall be Class 3 chairs with integral plates or precast concrete blocks not less than 4 inches square.

2.3 CAST-IN-PLACE CONCRETE

- A. Concrete Materials:
 - 1. Portland cement: ASTM C150/C150M; Type II. Cement shall be furnished from one source during the project.
 - 2. Blended cements: ASTM C595/595M. Do not use blended cements conforming to ASTM C595/595M if they contain cements conforming to ASTM C1157/C1157M.
 - 3. Supplementary Cementitious Materials:
 - a. Ground Granulated Blast Furnace Slag: ASTM C989 - Grade 100 or 120.
 - b. Fly Ash: ASTM C618 - Type F
 - 4. Aggregates:
 - a. Prohibited: crushed hydraulic cement concrete for aggregate.
 - b. Fine aggregate shall consist of washed inert natural sand, free from mineral or other coatings, soft particles, clay, loam, organic or other deleterious materials conforming to the requirements of ASTM C33/C33M and the following requirements:

SIEVE NO.	PERCENT PASSING
4	95 to 100
8	80 to 100
16	50 to 85
30	25 to 60
50	5 to 30
100	0 to 10

The Fineness Modulus shall be between 2.3 to 3.1. The percentage retained between any two consecutive sieves shall not exceed 45%. Color of supernatant liquid above test sample tested in accordance with ASTM C40 shall not be darker than organic plate No. 3.

- c. Coarse aggregate shall consist of a well graded crushed stone or a washed gravel conforming to the requirements of ASTM C33/C33M and the following requirements:

SIEVE	PERCENT PASSING			
	NO. 8 (3/8")	NO. 67 (3/4")	NO. 57 (1")	NO. 467 (1 1/2")
1-1/2 inch	-	-	100	95-100
1 inch	-	100	95-100	-
3/4 inch	-	90-100	-	35-70
1/2 inch	100	-	25-60	-
3/8 inch	85-100	20-55	-	10-30
No. 4	10-30	0-10	0-10	0-5
No. 8	0-10	0-5	0-5	-
No. 16	0-5	-	-	-
No. 50	-	-	-	-

The limits of deleterious substances and physical property requirements shall be listed in ASTM C33/C33M, Table 4, for severe weathering regions.

- d. Aggregate reactivity testing:
- i. Perform testing on the aggregate in accordance with ASTM C1260 (Rapid Mortar Bar Test).
 - ii. Do not use aggregate having a 14 day expansion greater than 0.10% (considered potentially reactive).
 - iii. Evidence of a satisfactory service record in lieu of testing for alkali reactivity is not permitted.
5. Water: Potable, from municipal water supply.
- B. Admixtures:
1. Low Range Water Reducer: MasterPozzolith 210 by BASF; WRDA with HYCOL by W.R. Grace & Company; or equivalent meeting ASTM C494 Type A.

2. High Range Water Reducer (superplasticiser): Rheobuild 1000 or Glenium 3000 NS by BASF; Daracem 100 or ADVA 140M by W.R. Grace & Company; or equivalent meeting ASTM C494 Type F.
3. Water reducing-retarding agents: for use when ambient temperature is above 70°F, replace water reducing agent in whole or in part with water reducing-retarding agent meeting ASTM C494 Type D. Use amounts to produce concrete with a set time equal to that at 70°F without the retarder.
4. Air entraining agent: Micro-Air by Master Builders, DAREX II AEA by W.R. Grace & Company; or equivalent meeting ASTM C260.
5. Non-corrosive non-chloride accelerator: Pozzutec 20+ by BASF; Polarset by W. R. Grace; or equivalent meeting ASTM C494 Type C or E.
6. Not permitted: Calcium chloride, thiocyanates or admixtures containing chloride ions.
7. All admixtures used for each mix design shall be from one common manufacturer.

C. Concrete Mix Design

1. Concrete Class:
 - a. Class A: Reinforced concrete structures
 - b. Class B: Conduit Encasements
2. Mix Design:
 - a. Class A: $f'c = 4,500$ psi, max $w/cm = 0.42$
 - b. Class B: $f'c = 3,500$ psi, max $w/cm = 0.50$
3. Maximum nominal aggregate size:
 - a. Class A: No. 67 ($\frac{3}{4}$ ")
 - b. Class B: No. 8 ($\frac{3}{8}$ ")
4. Air entrainment:
 - a. All concrete shall be air entrained in accordance with the nominal maximum aggregate size, with a tolerance of plus or minus 1.5%:
 - b. No. 8 ($\frac{3}{8}$ ") – 7.5%
 - c. No. 67 ($\frac{3}{4}$ ") – 6.0%
5. Cement: The proposed mix design shall contain cementitious materials in the following proportions
 - a. Portland Cement - No less than 50% of the total by weight.
 - b. Ground Granulated Blast Furnace Slag - No greater than 35% of the total by weight.
 - c. Fly Ash - No greater than 25% of the total by weight.
6. The slump shall be 4" with a 1" plus or minus tolerance at the point of delivery, without use of a high range water reducer. When a high range water reducer is used, the slump shall be as stated above before it is added, and a maximum of 8" at the point of delivery after it is added
7. Water:
 - a. The amount of water carried on the aggregate and the effect of admixtures is included in the water content. Provide that water carried on the aggregate is determined periodically by test and the amount of free water on the aggregate is subtracted from water added to the mixture.

- b. Maximum amount of water: that required to produce a plastic mixture of the strength and water to cementitious materials ratio specified and the required density, uniformity and workability. Consistency of the mixture: that required for the specific placing conditions and methods.
- 8. High Range Water Reducing admixtures shall be used for all concrete to be pumped or with a specified water/cement ratio below 0.50. High range water reducer shall be added either at the concrete batch plant or on site to obtain the slumps as indicated above.
- 9. Concrete shall be furnished from one supplier and batch plant during the project.
- 10. The Concrete producer shall select the concrete mix proportions on the basis of past field performance or the use of trial mixes, both in accordance with ACI 301, Section 4, "Concrete Mixtures".

2.4 ACCESSORIES

- A. Expansion Joint Fillers (Expansion joints and slab perimeter joints):
 - 1. For joints less than ½" thick: J-Joint polyethylene foam with tear off strip for sealant or equivalent; joint filler to be slab thickness in depth less 0.5 inch for sealant. Foamtastic by Hohmann & Barnard Co., Stripoff by AH Harris, or equivalent
- B. Epoxy bonding adhesive: Epoxy resin/portland cement moisture resistant bonding agent: Armatec 110 EpoCem by Sika Corporation, Corr-Bond by Euclid Chemical Company, Epobond by L&M Construction Chemicals, Inc. or equivalent.

2.5 CURING MATERIALS

- A. Curing and Sealing Compound:
 - 1. Conform to ASTM C309 Type 1 Class B.
 - 2. Acceptable manufacturers:
 - a. Emulsion Kurseal 309 by A.H. Harris & Sons, Inc.
 - b. Aqua-Cure VOX by Euclid
 - c. Starseal EF Cure 500 by Vexcon
 - d. Or equivalent.
- B. Curing Water: Water shall be potable from a municipal water supply and shall be free of materials that have the potential to stain concrete. The temperature of the curing water shall not be lower than 20°F cooler than the surface temperature of the concrete at the time the water and concrete come in contact.
- C. Curing Blanket: ASTM C171. Cellulose fabric sheets with an impervious layer on one side. Conkure by Raven Industries, UltraCure by Sika Industries.
- D. Curing Paper: ASTM C171, regular or white waterproof paper.

2.6 FINISHING MATERIALS

- A. Slab Hardener:
 - 1. Fluorosilicate water based.
 - 2. Acceptable manufacturers:
 - a. Tammolith by Tamms (Euclid Chemical Co.)
 - b. Lapidolith by Sonneborn

- c. Fluohard by L&M
- d. Or equivalent

2.7 REPAIR MATERIALS FOR STRUCTURAL DEFECTS

- A. Epoxy Adhesive:
 - 1. Two or three part water based epoxy bonding agent with cementitious components
 - 2. Acceptable manufacturers:
 - a. Arimatec 110 Epocem by Sika Corporation
 - b. Corr-Bond by Euclid Chemical Co.
 - c. MasterEmaco P 124 by Master Builders
 - d. Or equivalent
- B. Repair of random cracks (dry – free of liquid or moisture):
 - 1. 2-component, 100% solids, moisture-tolerant, low-viscosity, high-strength, multipurpose, epoxy resin adhesive.
 - 2. Acceptable manufacturers:
 - a. Sikadur 35 Hi-Mod LV by Sika Corporation
 - b. Eucopoly Injection Resin by Euclid Chemical Co.
 - c. MasterInject 1500 by Master Builders
 - d. Or equivalent
- C. Repair of random cracks (wet - presence of liquid or moisture):
 - 1. Low viscosity polyurethane resin that expands and forms a closed cell foam when it comes in contact with water.
 - 2. All cracks that are wet (either damp or leaking) at the time of repair shall be repaired with a material that is specifically intended for wet repair as recommended by the manufacturer.
 - 3. Acceptable manufacturers:
 - a. SikaFix HH Hydrophilic by Sika Corporation
 - b. Dural Aqua-Fil by Euclid Chemical Co.
 - c. MasterInject 1210 IUG by Master Builders
 - d. Or equivalent
- D. Repair of spalls, honeycombs areas and holes:
 - 1. Polymer modified, non-sag cementitious repair mortar with corrosion inhibitor.
 - 2. Repair material shall include peastone for repairs of greater depth as required by the manufacturer. For repair areas involving depths generally in excess of three (3) inches, utilize a repair material suitable for the depth of repair.
 - 3. Acceptable manufacturers:
 - a. SikaTop 123 Plus by Sika Corporation
 - b. Tamms Structural Mortar by Euclid Chemical Co.
 - c. MasterEmaco N 400
 - d. Or equivalent
- E. All repair materials shall be installed in accordance with the manufacturer's recommendations.

2.8 NON-SHRINK GROUT

- A. Cementitious grout: consists of premeasured, prepacked flowable cement based grouting material with aggregate requiring only the addition of water.
- B. Aggregates: ASTM C33/C33M fine aggregate, washed
- C. Pea Stone: ASTM C33/C33M coarse aggregate, size number 8 (max. size 0.375 inches), washed
- D. Water: Potable, from municipal water supply.
- E. Utilize proper grout for the intended application as recommended by the manufacturer.
- F. All grouts shall achieve a minimum 28 day strength of 6,000 psi according to ASTM C109/C109M.
- G. Grouts when tested by flow cone according to CRD-C 611 shall take more than 20 seconds to flow as a maximum limit on fluidity.
- H. Test grout when requested.
- I. Acceptable Products:
 - 1. Five Star Grout - Five Star Products, Inc
 - 2. Masterflow 928 - BASF / Master Builders
 - 3. NS Grout - Euclid Chemical Company
 - 4. Crystex - L&M Construction Chemical, Inc.
 - 5. Harris Construction Grout – A.H. Harris & Sons, Inc.
 - 6. Or equal

PART 3 - EXECUTION

3.1 FORMWORK

- A. Conform to ACI 301.
- B. Verify lines, levels and measurements before proceeding.
- C. Erect plumb and straight. Maintain rigid. Brace sufficiently.
- D. Allow no concrete leakage. Provide continuous, straight, smooth exposed surfaces.
- E. Treat forms with form release agent prior to erecting forms. Protect reinforcing from contact with form release agent. Any and all form release agent that contacts reinforcing shall be thoroughly removed.
- F. Earth forms not permitted for below grade walls, slabs and footings.
- G. Chamfer all exposed outside corners and edges 0.75 inch unless otherwise noted.
- H. Clean out inside of forms of all foreign materials prior to concrete placement.
- I. Install reinforcing steel spacers as required.
- J. Maintain specified tolerances.
- K. Maintain vertical forms and shores supporting the cast concrete for the time periods indicated below:
 - 1. Walls and Vertical Surfaces: 36 hours
 - 2. Forms may be unlocked after 24 hours but shall remain in place for the indicated time periods
 - 3. Time period listed above represents cumulative number of days or hours during which the temperature of the air surrounding the concrete is above 50°F and the concrete has been damp and no loss of moisture has occurred.
- L. Clean and repair surfaces of forms to be re-used in work. Split, frayed,

delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form release agent as specified for new formwork.

3.2 REINFORCEMENT

- A. Conform to the CRSI Code of Standard Practice.
- B. Do not weld reinforcement unless the Engineer takes no exceptions - in writing. When permitted, welding shall be in accordance with AWS D1.4/D1.4M.
- C. Splicing reinforcing steel:
 - 1. Reinforcing bars: Splices shall be located as shown on the Contract Drawings. Minimum splice lengths shall be as indicated on the Contract Drawings.
- D. Provide bar supports: on grade use concrete brick; elsewhere use manufactured wire supports.
- E. Reinforcement shall be securely tied at intersections with tie wire or clips in a manner that will keep all metal away from exposed concrete surfaces.
- F. Cutting, heating and bending of reinforcement embedded in the concrete will not be allowed
- G. All reinforcement within an area of a continuous concrete placement shall be installed, supported, and secured before beginning concrete placement.

3.3 EMBEDDED ITEMS

- A. Contractor shall coordinate the installation and securing of all embedded items such as conduit, reinforcing steel dowels and all other required embedded items indicated in the Contract Documents.
- B. Pipes or conduits for embedment within a slab, wall or beam, other than those merely passing through, shall satisfy the following:
 - 1. Shall not be larger in outside diameter than one-third (1/3) the thickness of the slab or wall.
 - 2. Shall not be spaced closer than 3 diameters on center.
 - 3. Shall not impair significantly the strength of the concrete.
 - 4. Only two conduits or pipes shall cross at any point. The sum of the outside diameter of the crossing pipes or conduits shall not exceed one-third (1/3) of the thickness of the concrete thickness.
 - 5. Conduit shall not be located between the bottom of reinforcing steel and bottom of concrete slab.
 - 6. Aluminum conduit shall not be embedded in concrete.
 - 7. Conduit shall be installed such that there will be NO cutting, bending, and/or displacement of reinforcing from its proper location.
 - 8. Conduit shall not be installed prior to review of conduit layout plan with no exceptions taken by the Engineer.
 - 9. Bondouts in concrete slabs or walls for pipes or conduit shall not be installed unless reviewed with no exceptions taken by the Engineer.

3.4 EXPANSION ANCHORS AND EPOXY ADHESIVE ANCHORS

- A. Anchors shall be installed by qualified personnel trained to install adhesive anchors.

- B. Anchors shall be installed in strict accordance with the Manufacturer's Printed Installation Instructions (MPII).
- C. Each installer shall at all times have in their possession the MPII.
- D. Adhesive anchors shall be installed in concrete having a minimum age of 21 days at time of installation.
- E. All adhesive anchor cartridges shall have the expiration date clearly visible. Material past its expiration date shall not be used, and shall be immediately removed from the site.
- F. Embedded reinforcement shall be located with proper equipment prior to drilling to ensure that each drilling location does not coincide with existing reinforcement. Drilling through reinforcement shall be prohibited.
- G. If existing reinforcing steel is encountered while drilling, offset the drill hole by a maximum of 2-inches. The new relocated hole shall be in the same line as the line of drilled holes. All offset holes shall be a minimum of 4-inches from a free concrete edge. Maintain the original spacing locations of the remaining dowels as indicated on the Contract Drawings.
- H. Diamond drill bits shall not be permitted. Hammer drills shall be used.
- I. The initial material extruded from each adhesive anchor cartridge shall be discarded in accordance with the manufacturer's instructions to ensure that all material is properly mixed.
- J. Depth stop shall be used to ensure correct drilling depth. Drilled holes shall be blown out with air, thoroughly wire-brushed with a repeated back and forth movement, blown out, thoroughly wire-brushed, and blown out again. Adhesive shall be injected starting from the bottom of the hole, and slowly withdrawn as filling progresses to prevent air pockets.

3.5 PLACING CONCRETE

- A. Notify Engineer and Independent Testing Laboratory 24 hours' minimum prior to each placement.
- B. All reinforcement within the area of one day's concrete placement shall be tied in place, and observed by the Engineer, prior to commencing concrete placement.
- C. All concrete delivery trucks at each placement shall be tested for slump and air content.
- D. Assure placement and proper location of all embedded items.
- E. Provide concrete Delivery Slip prepared at batch plant with each truck load of concrete showing the information listed under Submittals in this Section.
- F. Water: additional water added to the mix shall be carefully monitored as follows:
 - 1. Residual, wash, and/or other water in drums: completely discharged prior to concrete batching (drums backed out).
 - 2. Slump adjustment: additional water shall not be added from the time of batching to the point of delivery at the Project site.
 - 3. Water added after arrival at Project site: accurately metered and recorded on the delivery ticket. The amount of water withheld from batching shall be clearly indicated on the delivery slip. The total water added at the site shall include water added for the truck and water added to the drum from any initial washdown.
- G. Place concrete from mixing truck to final location quickly and without

segregation.

- H. Place all concrete from the delivery truck within 90 minutes of addition of water to cement, or cement to aggregate, whichever occurs first. When air temperature is 90°F and above, this time shall be reduced to 60 minutes. These times may be exceeded only upon review with no exceptions taken by the Engineer, and only if all tests for air content, slump and temperature are also within specified limits.
- I. Standing water shall be removed from all forms and excavations and the Work shall be kept dry during concrete placement. No water shall be thrown on, allowed to flow over, or rise upon the concrete until it is thoroughly set.
- J. Concrete truck chute shall conform to the following:
 - 1. Minimum slope: 3 horizontal to 1 vertical. Maximum slope: 2 horizontal to 1 vertical. Between these limits the chute slope shall be such to ensure continuous flow without segregation.
 - 2. Provide baffle at end of chute to prevent segregation. If the end of the chute is more than 3 feet above the surface of deposit, a spout is to be used. The spout is to be kept full of concrete with the end kept as near as practical to the surface of the deposit.
 - 3. The chute shall be steel or steel-lined. Aluminum chutes are not permitted. Sections of the chute shall have the same slope throughout.
 - 4. The chute is to be thoroughly flushed with water before and after each use with the water discharged outside the forms.
- K. Freefall from concrete truck discharge chute, pump hose and hopper hose: 4 feet maximum.
- L. The accumulation of concrete on the forms and/or reinforcement above the level of placement shall be avoided. The splashing of concrete upon formwork that is set for a subsequent concrete placement shall be prevented due to the resulting marks on the finished concrete.
- M. Concrete placements shall be carried out in a continuous operation until the placement of the entire section between construction joints is complete. Place against plastic concrete only.
- N. Do not place partially hardened concrete. Re-tempering is not permitted.
- O. Compacting and vibrating concrete:
 - 1. Concrete may be deposited in one or multiple layers. Consolidate each layer by mechanical internal vibrating equipment supplemented by hand spading, rodding, and tamping as required. The depth of each layer shall not exceed the smaller of 20 inches and the depth that can be properly vibrated with the equipment used. When deposited in multiple layers, the vibrator shall penetrate the preceding layer approximately 6 inches to blend layers. Ensure that initial setting of the previous layer doesn't occur prior to placement of subsequent layer.
 - 2. Do not use vibrator to move fresh concrete within the forms. Insert vibrator at approximately 18 inch intervals, and over-vibration resulting in segregation shall be prevented.
 - 3. Concrete shall be thoroughly consolidated around reinforcement, embedded items and into corners of forms.
- P. Placing concrete in cold weather:

1. Conform to ACI 306.1 for concrete placements in cold weather as defined below. When freezing temperatures may occur during periods not defined as cold weather, concrete surfaces shall be protected against freezing for at least the first 24 hours after placement.
2. Cold Weather:
 - a. Cold weather is defined as any and all periods when for more than three consecutive days the average daily outdoor temperature drops below 40°F. (The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight.) When temperatures higher than 50°F occur during more than half of any 24-hour duration, the period shall not be regarded as cold weather.
 - b. When freezing temperatures may occur during periods not defined as cold weather, concrete surfaces shall be protected against freezing for at least the first 24 hours after placing.
3. Concrete shall conform to the following temperature limitations when delivered to the project site:

		Concrete Thickness			
Item	Air Temperature	Less than 12 in	12-36 in	36-72 in	Greater than 72 in
Minimum concrete temperature as placed and maintained					
1	--	55°F	50°F	45°F	40°F
Minimum concrete temperature as mixed for indicated air temperature					
2	Above 30°F	60°F	55°F	50°F	45°F
3	0 to 30°F	65°F	60°F	55°F	50°F
4	Below 0°F	70°F	65°F	60°F	55°F

4. The concrete mixing temperature shall not be higher than the minimum concrete placement temperature (Items 2-4 in the table above) by more than 15°F.
5. An Accelerator may be used in the mix design when placing concrete in air temperatures below 50°F.
6. All material and equipment required for cold weather placement, protection and curing shall be available at the project site before commencing concrete placement.
7. Any enclosure for weather and climate protection shall be in place before depositing any concrete. Heating within the enclosure shall maintain the temperature specified with a reasonable degree of uniformity in all parts of the enclosure. All exposed concrete surfaces within the enclosure shall be kept sufficiently moist to prevent drying. Heating appliances shall not be placed in a manner so as to damage the enclosure, forms, supports, or expose any area of concrete to drying out or to excessive temperatures.
8. All snow, ice and frost shall be removed from the surfaces against which the concrete is to be placed including subgrade and reinforcement.
9. Do not place concrete on frozen ground. Insulate or heat subgrade to ensure temperature of subgrade material is above 32°F when concrete is placed.

10. All embedded items having a cross sectional area of 1.00 square inches or greater, including #9 and larger reinforcing steel bars shall be at a temperature not less than 10°F at time of concrete placement.
 11. Cover, insulate and/or heat as required to protect concrete and provide frost protection beneath structure. Thermal protection shall be provided immediately after concrete placement. Except when supplemental heat is provided, the R-value of the insulation shall be per the recommendations of Chapter 9 of ACI 306R.
- Q. Placing concrete in hot weather:
1. Hot Weather: Job-site conditions that accelerate the rate of moisture loss or rate of cement hydration of freshly mixed concrete, including an ambient temperature of 80°F or higher, and an evaporation rate that exceeds 1 kg/m²/h.
 2. Temperature of concrete when placed shall not exceed 90°F. When the air temperature is 90°F and above, procedures to cool mixture ingredients shall be employed. These include:
 - a. Providing shaded storage for aggregate,
 - b. Frequent sprinkling or fog spraying of coarse aggregate,
 - c. Using chilled batch water and/or ice.
 3. Forms and reinforcement shall be sprinkled with cold water just prior to concrete placement. When possible, placement of slabs should be scheduled accordingly in order to minimize problems associated with direct sunlight and/or drying winds.
- R. Pumping: The inside diameter of pipes and hoses used to convey the concrete shall be a minimum of three times the maximum size aggregate of the mixture. In order to minimize altering the concrete properties, long vertical sections at the end of the pump line is prohibited. A horizontal hose run, a hose loop, or a slide gate at the end of the hose is to be used to reduce loss of entrained air.
- S. Thoroughly moisten subgrade materials prior to placing slabs on grade.
- T. When placing new concrete directly against existing concrete, clean the surface of all contamination and debris, and roughen by steel shot-blasting, abrasive (sand) blasting, or water-jetting (hydrodemolition). Use of scabblers, scarifiers, bush hammers, or pneumatic hammers is not permitted. The prepared surface shall be water-saturated for a minimum of six hours, and the excess water shall be removed immediately prior to placement of concrete. Apply epoxy bonding agent to the prepared surface to bond to new concrete.
- U. Provide concrete pads and foundations for all equipment as shown on Drawings or as required by the equipment manufacturer. Set anchor bolts for equipment with templates at correct elevations using manufacturer's shop drawings reviewed by the Engineer with no exceptions taken unless otherwise indicated. All equipment pads shall be sized by the Contractor and equipment supplier.
- V. Contractor shall coordinate concrete truck wash-out area with Owner.

3.6 TESTING CAST-IN-PLACE CONCRETE

- A. An Independent Testing Laboratory, selected and paid for by the Owner and directed by the Engineer and/or Resident Project Representative, shall test and sample Class A concrete for strength, slump and air content as indicated herein.

- B. The General Contractor shall notify the Independent Testing Laboratory of proposed upcoming concrete placements as follows.
 - 1. The General Contractor shall notify the Testing Laboratory of proposed concrete placements on a weekly basis.
 - 2. The General Contractor shall notify the Testing Laboratory of specific placements a minimum of 24 hours in advance.
- C. Obtain 4 standard test cylinder samples measuring 6"Ø x 12" or 7 test cylinders measuring 4"Ø x 8" for each class of concrete placed in any one day at the following frequency:
 - 1. For each 100 cubic yards of placed concrete, or
 - 2. For each placement less than 100 cubic yards
- D. Concrete cylinders shall be tested as follows:
 - 1. 6"Ø x 12" cylinders:
 - a. Test one cylinder at 7 days; two cylinders at 28 days
 - b. Hold one cylinder for later testing (if required)
 - 2. 4" Ø x 8" cylinders:
 - a. Test two cylinders at 7 days; three cylinders at 28 days.
 - b. Hold two cylinders for later testing (if required)
- E. Perform slump tests and air entrainment tests at the project site on each truck and at each sampling. Perform slump and air entrainment tests both before and after any permitted slump adjustment.
- F. Sample concrete for testing of air and slump at the discharge end of the truck. When concrete is pumped, concrete taken for test cylinders shall be at the discharge end of the pump hose. All concrete sampled for testing shall be taken from the beginning of the concrete truck discharge. All concrete sampled for casting of cylinders shall be taken from the middle third of the concrete truck discharge. No concrete shall be placed until the testing is complete.
- G. Perform strength, slump and air entrainment tests at other times when directed by the Resident Project Representative.
- H. Additional testing and sampling required as a result of deficient results or improper curing shall be paid for by Owner. The cost of resampling and retesting will be determined by Engineer, and Owner will invoice Contractor for this cost. If unpaid after 60 days, this invoice amount will be deducted from the Contract Price.
- I. Owner's independent concrete testing agency shall provide and maintain an insulated, heated concrete cylinder curing box, 4 foot square minimum in size. Contractor shall provide required power to the curing box. It shall provide an environment that prevents moisture loss from the cylinders, and the temperature shall be maintained between 60°F and 80°F, recorded with a maximum-minimum thermometer. Heating and cooling devices shall be used, if necessary. Independent Testing Agency shall coordinate the location of the curing box with the Resident Project Representative and Contractor.
- J. Contractor shall provide access to the site at all times for the Independent Testing Laboratory Personnel.
- K. Additional concrete tests:

1. Independent Testing Laboratory shall provide additional testing of in-place concrete that does not comply with the requirements of the Contract Documents or is considered substandard as directed by Engineer. Additional tests may consist of non-destructive testing, cores drilled from the area in question or load tests. Costs of additional testing will be paid by Owner. The cost of the additional testing will be determined by Engineer and Owner will invoice Contractor for that cost. If unpaid after 60 days, the invoice amount will be deducted from the Contract Price.
2. When the concrete strength is substandard as defined in this Section, concrete core specimens shall be obtained and tested from the affected area. A minimum of three (3) cores shall be taken for each sample in which the strength requirements were not met. The drilled cores shall be obtained and tested in conformance with ASTM C 42. Engineer will determine the size and location of the required core samples.

3.7 FINISHING SLABS AND FLATWORK

- A. Screed to bring concrete surface to proper contour and elevation.
- B. Highway straightedge, bull float or darby float the concrete surface immediately after screeding.
- C. Allow bleed water to evaporate or remove. Means to accelerate drying such as applying dry cement, sand, and other materials shall be prohibited.
- D. After completion of the above listed procedures, provide one of the concrete finishes listed below as indicated in the Schedule of Finishes:
 1. (FF) Float Finish: Allow concrete to stiffen. Float surface twice or more with a hand float, bladed power float or powered disk float to a uniform sandy texture.
 2. (LTF) Light Trowel Finish: Provide Float Finish. Apply trowel with a minimum number of passes to provide a sealed surface free of trowel marks.
 3. (LBF) Light Broom Finish: Perform wood float finish as indicated above. While plastic draw a soft-bristled broom, over the concrete in long even strokes with downward pressure. Broom transverse to traffic or at right angles to the slope of the slab.
 4. (SF) Scratch Finish: Roughen the surface with stiff brushes or rakes before final setting.
- E. Schedule of Finishes:
 1. Interior slabs:
 - a. Finish: LTF
 - b. Curing:
 - i. Moist cure. Apply slab hardener.

3.8 VERTICAL FORMED SURFACE FINISHES

- A. Concrete surfaces "exposed to view" shall be defined as those exposed to view upon completion of the WorkSurfaces which will be covered by fill, such as exterior faces of walls, shall not be considered exposed to view.
- B. Surface tolerance classes indicated herein are specified in ACI 117, and include abrupt surface irregularities that are measured within 1-inch of the irregularity, and gradual surface irregularities measured as the maximum gap between the

concrete and the near surface of a 5-foot straight-edge, measured between contact points.

- C. Surface Finish-1.0 (ESF-1.0):
 - 1. Patch voids larger than 1 1/2 inch wide or 1/2 inch deep.
 - 2. Remove projections exceeding 1 inch in height .
 - 3. Form tie holes need not be patched.
 - 4. Repair surface and structural defects as indicated in this Section.
 - 5. Surface tolerance Class D with formed surface irregularities not more than 1 inch.
- D. Environmental Surface Finish-3.0 (ESF-3.0):
 - 1. The concrete surface shall be of uniform color, texture and free of all irregularities.
 - 2. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the minimum.
 - 3. Patch voids larger than 3/4 inch wide or 1/4 inch deep.
 - 4. Projections exceeding 1/8 inch in height to be removed by grinding and/or rubbing.
 - 5. Patch form tie holes.
 - 6. Repair surface and structural defects as indicated in this Section.
 - 7. Surface tolerance Class A in accordance with ACI 117.
 - 8.
- E. Grout-Cleaned Rubbed Finish (GCRF):
 - 1. Provide an ESF-3.0 finish as specified above.
 - 2. The wall surface shall have all loose dirt, scale, etc. removed.
 - 3. The surface shall be wetted and allowed to soak the surface. The surface being worked on shall not be in the sun while finishing. Curing in the sun is acceptable.
 - 4. The grout mixture shall be one part portland cement and 1 1/2 parts sand (by volume) and enough water to produce the consistency of thick paint matching the color of the surrounding concrete. After the materials are mixed, let set for at least 15 minutes.
 - 5. The sand and portland cement shall be obtained from the concrete plant where the concrete was obtained and shall be the same sand and the same cement as used in the concrete.
 - 6. Scrub grout into voids and remove excess grout.
- F. Schedule of Finishes:
 - 1. Exterior wall surfaces exposed to view from top of walls to 6" below grade
 - a. Finish: GCRF
 - b. Curing: Moist cure
 - 2. Exterior below grade wall surfaces not exposed to view
 - a. Finish: SF-1.0
 - b. Curing: Moist cure

3.9 CURING

- A. Curing: Curing shall begin immediately following the initial set of concrete or after slab surface finishing has been completed when it will not mar, erode or stain the concrete surface and shall continue after form removal. All concrete

shall be cured to attain strength and durability by the following method for a minimum of seven consecutive days immediately after placement regardless of the ambient air temperature:

1. Moist Cure
 - a. Ponding or continuous sprinkling. Intermittent wetting and drying is not an acceptable curing method.
 - b. Application of curing blankets kept continuously wet.
 - c. Application of curing paper kept continuously wet. Lap side joints 4 inches, and end joints 6 inches. Tape joints or weigh down paper to prevent displacement. Repair any and all tears during the curing period. Apply paper no earlier than 24 hours, and no later than 30 hours, after finishing. Use wet methods for the first 24 to 30 hours. The slab surface shall be maintained in a wet condition beneath the paper at all times.
2. Application of concrete curing compounds.
 - a. The use of curing compounds on surfaces to receive chemical hardeners or a rubbed or bonded finish will not be allowed.
- B. For formed concrete, apply immediately after form removal. Moisture loss from surfaces placed against wooden or metal forms exposed to heating by the sun shall be minimized by keeping the forms wet until they can be safely removed.
- C. After form removal of vertical elements, the concrete shall be cured as indicated for the balance of time remaining as specified above. All exposed concrete (tops of walls) within vertical forms shall begin moist curing within 24 hours of placement, regardless of the duration that the forms will remain in place.
- D. Cold Weather:
 1. Unless otherwise superseded by the requirements within this Specification, conform to ACI 306.1 for placement of concrete in cold weather as defined in Part 1.6.
 2. Thermal protection must be provided immediately after concrete placement. Procedures for covering, insulating, housing and/or heating concrete shall be prearranged. Except when supplemental heat is provided, the R-value of the insulation shall be in accordance with the recommendations of Chapter 9 of ACI 306R.
 3. Concrete structures shall be covered, insulated and heated as required to prevent frost penetration beneath the structures.
 4. Maintain concrete at the following minimum temperature (measured at concrete surface) for a minimum protection period of 6 days:
 - a. Sections of less than 12 inch minimum dimension: 55°F
 - b. Sections of 12 to 36 inch minimum dimension: 50°F
 5. Protect concrete from damage due to concentrated heat sources to minimize local carbonation of the concrete surfaces. Combustion heaters shall be located so they do not apply heat directly to the concrete surfaces.
 6. For those surfaces requiring curing compounds, reapply curing compounds every two days during heating period or at greater frequencies as required by the manufacturer.
 7. The temperature shall be monitored at the surface of the concrete, including corners and edges, which are more vulnerable to low temperature. The

concrete surface temperature shall be recorded a minimum of twice per each 24 hour period.

8. Slabs, regardless of air content, shall not be exposed to freezing temperatures (those 32°F and below) when exposed to rain, snow or other water sources, prior to reaching a compressive strength of 3500 psi.
9. Concrete shall be cooled gradually at the end of the protection period. The maximum allowable temperature drop of the concrete surfaces during the first 24 hours after the end of the curing period shall not exceed 5°F in any 1 hour and shall not exceed the following total gradual temperature drop in the first 24 hours:
 - a. Sections of less than 12 inch minimum dimension: 50°F
 - b. Sections of 12 to 36 inch minimum dimension: 40°F

E. Hot Weather:

1. Unless otherwise superseded by the requirements within this Specification, conform to ACI 308.1 for curing of concrete in hot weather as defined in Part 1.6.
2. Concrete temperature as delivered to the project site shall not be greater than 90°F. Protect from loss of slump, flash set, plastic cracking and rapid evaporation of water.
3. Place concrete quickly, shade from direct sun and protect from wind.

3.10 JOINTS

A. Prepare joints as follows:

1. Horizontal joints: remove laitance immediately after initial set and roughen surface in an acceptable manner that exposed the aggregate uniformly and doesn't leave laitance or loose aggregate. After the concrete has set to a stiffness that precludes laitance removal by shovels or scrapers, the Contractor shall remove it and create a roughened surface by water-jetting or other effective method. The use of pneumatic hammers is not permitted.
2. Vertical joints: the surface shall be thoroughly cleaned of laitance by water-jetting or wire-brushing followed by air blasting.
3. Before concrete is placed against set concrete, the surface shall be thoroughly wetted with standing water removed. Horizontal construction joints shall be in a saturated surface dry condition: saturated for a minimum of 6 hours, with standing water removed.

3.11 REPAIRS TO CONCRETE (GENERAL)

A. Definitions:

1. Honeycombed areas: Areas where voids are left in the concrete due to inadequate vibration and consolidation resulting in a failure of the mortar to effectively fill the spaces among coarse aggregate particles.
2. Spalls: Concrete that has chipped, flaked, scaled or broken off from the surface of the concrete.
3. Surface Defects: Those defects that affect the appearance of the finished concrete but do not affect the structural integrity.
4. Structural Defects: Those defects that affect the appearance of the finished concrete and the structural integrity.

- B. Surface Defects:
 - 1. Form tie holes
 - 2. Air voids larger than the maximum void size specified for the required finish (ESF-2.0 or ESF-3.0).
 - 3. Small honeycomb areas with a nominal diameter or depth greater than ¼ inch and less than 1 inch
 - 4. Blisters
 - 5. Delaminations
 - 6. Crusting
 - 7. Visible construction joints, fins and burs
 - 8. Non-uniform concrete color and appearance
 - 9. Floors that are not level
- C. Structural Defects:
 - 1. Random cracks
 - 2. Spalls
 - 3. Large honeycombed areas with a nominal diameter or depth greater than 1 inch
 - 4. Holes in the concrete surface with a nominal diameter or depth greater than 1 inch

3.12 REPAIRS OF SURFACE DEFECTS

- A. As soon as the forms have been stripped and the vertical concrete surfaces exposed or concrete slabs have been finished and cured, repair all surface defects. All concrete repair work shall result in a concrete surface of uniform color and texture, and shall be free of all irregularities.
- B. Form Tie Holes: After cleaned and thoroughly dampened, apply grout paint and fill holes solid with patching mortar.
- C. Air voids: After cleaned and thoroughly dampened, apply grout paint and fill holes solid with patching mortar.
- D. Honeycomb areas (small):
 - 1. All honeycombed areas shall be removed to sound concrete by means of hand chisels or pneumatic chipping hammers or hydrodemolition.
 - 2. Saw cut a 1 inch minimum square groove around the edges of the defective area perpendicular to the surfaces to serve as the boundary for concrete removal. Saw cut the edges perpendicular to the surface. No feather-edges shall be allowed.
 - 3. Remove all loose aggregate paste and debris and scrub clean. Thoroughly wet area to be repaired. Brush and scrub grout paint into the substrate of the area to be repaired.
 - 4. Mix patching mortar using as little water as possible. Allow to stand with frequent manipulation of trowel to achieve stiffest consistency. Blend white and gray Portland cement to achieve color match with surrounding concrete.
 - 5. Prior to the set of grout paint (but after it has cast its water sheen), apply a stiff consistency of patching mortar to the area with a trowel. Leave patched surface slightly higher than surrounding surface. Do not finish for 1 hour minimum. Cure in same manner as adjacent concrete.
- E. Blisters, delaminations and crusting: Repairs shall be similar to those for

honeycomb areas. Depth of saw cut shall match the depth of the defective concrete.

- F. Visible construction joints, fins and burrs: Remove by grinding until a smooth uniform surface is attained.
- G. Concrete with an overall non-uniform color or appearance as determined by the Engineer shall be repaired with a complete cementitious overlay.

3.13 REPAIRS OF STRUCTURAL DEFECTS

- A. Repair all structural defects in existing concrete that are identified by the Engineer during construction. These repairs are identified either on the Structural Drawings or in the Bid Form.
- B. Unless otherwise indicated, all concrete defects shall be repaired in accordance with the specific repair material manufacturer's recommendations.
- C. Random cracks:
 - 1. Crack or void must be dry at time of application. Remove all dust, debris or disintegrated material from cracks or voids by the use of oil-free compressed air or vacuuming. Cracks saturated with oil or grease must be chipped out to unsaturated concrete. "Vee" out cracks in horizontal surfaces slightly.
 - 2. Where cracks extend through members and are accessible, seal bottom of crack which is to receive the repair material.
 - 3. Patching of vertical wall or overhead cracks shall be accomplished in the same manner using a similar epoxy material of higher viscosity as recommended by the manufacturer.
 - 4. Materials shall be as indicated in Part 2 of this Specification. Apply repair material in strict accordance with manufacturer's recommendations.
- D. Spalls, honeycomb areas and holes:
 - 1. All weakened, damaged or disintegrated concrete shall be removed to sound concrete by means of hand chisels, pneumatic chipping hammers or hydrodemolition. If pneumatic chipping hammers exceeding 15 pounds are used, such use shall be followed by abrasive blasting.
 - 2. Saw cut a 1 inch minimum square groove around the edges of the defective area perpendicular to the surfaces to serve as the boundary for concrete removal. Saw cut the edges perpendicular to the surface. No feather-edges shall be allowed.
 - 3. Remove defective concrete. If defective areas extend around reinforcing steel, chip to provide a clear space of at least 1 inch all around the bar. When pneumatic chipping hammers are used for removal of concrete around reinforcement, they shall not exceed 15 pounds.
 - 4. Materials shall be as indicated in Part 2 of this Specification. Apply repair material in strict accordance with manufacturer's recommendations.

3.14 TOLERANCES

- A. Maximum allowable deviations from dimensions, elevations, slopes and position shall conform to ACI 117. Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel, dowels, or embedded items.

3.15 DEFECTIVE CONCRETE

- A. Any deficient concrete may be subject to rejection and replacement at no additional cost to the Owner if the Engineer deems necessary.

3.16 NON-SHRINK GROUT

A. Surface Preparation

1. Unless otherwise indicated, Follow manufacturer's written instructions.
2. Concrete surfaces shall be a minimum 28 days old.
3. Completely remove all loose concrete, aggregate, dust, laitance, dirt, oil, grease and other contaminants by bush-hammering, chipping, brushing, concrete cleaners or degreasers.
4. Use acceptable mechanical means to obtain clean, sound and rough concrete surfaces, exposing coarse aggregate. Blow surfaces clean of dust and debris using oil-free compressed air.
5. Soak concrete surfaces thoroughly for a minimum of 8 hours with potable water. Concrete shall be saturated and free of standing water at time of grout placement.
6. Follow manufacturer's cold and hot weather grouting procedures to maintain all materials and surfaces that contact grout within acceptable temperature ranges. Heat the substrate and surrounding environment to a minimum of 40° F.

B. Forms

1. Formwork shall be constructed of rigid nonabsorbent materials, securely anchored, watertight and strong enough to resist forces developed during grout placement.
2. Formwork shall be constructed so that the grout is placed across the shortest distance whenever possible. The clearance between formwork and baseplate shall be sufficient to allow for headbox. The clearance for remaining sides shall be one to three inches.
3. Height of formwork shall extend a minimum of one inch above the highest point to be grouted.
4. All formwork shall be coated with a form release agent or plastic sheeting for easy removal. Care should be taken not to contaminate grouting surfaces where bond is required.

C. Placing

1. Pouring:
 - a. A headbox or similar device is required for a continuous pour to avoid air pockets under baseplate. All grouting shall take place from one side to the other, maintaining contact with the bottom of the plate at all times.
 - b. When pouring through grout holes, placement shall proceed continuously with a headbox until the grout has risen in the next hole. Maintain head pressure at initial hole so that grout stays in contact with the bottom of the baseplate at all times.
 - c. Commence grouting at the next hole with an additional headbox. Continue process, alternating headboxes until grouting is complete.
 - d. When pouring into the headbox, grout shall be introduced in a manner to avoid air entrapment. Care must be taken during grouting to keep the

headbox at least half full of material to ensure even grout flow. If necessary to assist the flow, a plunger may be used. This procedure shall continue until the grout rises above the bottom edge of the baseplate on the opposite side.

- e. Throughout the pour, forms shall be constantly checked for leaks. All leaks shall be sealed immediately.
2. Dry Packing:
 - a. A dry-pack consistency is achieved when the mixed grout can be squeezed into a ball by hand without crumbling. Only enough water should come to the surface to moisten the hands.
 - b. Use a ram with a square cut end and hammer to evenly compact the grout against solidly braced backing boards, combining each layer (approximately 1/2 inch thick) to the previously placed layer over its entire surface.
 - c. Each placed layer shall be visually inspected for placement uniformity.
 - d. Striking force should be sufficient for compaction of the grout without affecting plate alignment.
 - e. Placement shall be continuous until grouting is complete.
- D. Finishing and Curing
1. Cut grout back from bottom of baseplate to the foundation at approximately a 45° angle. Formwork can be removed for cutback when grout offers stiff resistance, or when cut with a steel trowel, stands up without support.
 2. Provide smooth finish to exposed grout surfaces.
 3. Grout shall not be allowed to remain above the bottom edge of the baseplate.
 4. Moist cure for a minimum of three days.
 5. Protect from excessive evaporation with wet rags prior to set.
 6. Protect from wind, rain, freezing and vibration until a minimum compressive strength of 1000 psi is achieved.
 7. Maintain temperature above 45° F until a minimum compressive strength of 1000 psi is achieved.

END OF SECTION

SECTION 03420PRECAST CONCRETE STRUCTURESPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Precast concrete structures (includes all precast concrete structures greater than 6'-0" diameter or 6'-0" square)
- B. Joint sealants
- C. Leak testing

1.2 RELATED SECTIONS

- A. Section 01340 - Submittals
- B. Section 02200 - Earthwork
- C. Section 03300 - Cast-in-Place Concrete
- D. Section 05500 - Metal Fabrications
- E. Section 08305 - Special Doors
- F. Section 15092 - Pipe Sleeves and Seals

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. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.
- B. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials
- C. ACI 301 Specifications for Structural Concrete
- D. ACI 306.1 Specification for Cold Weather Concreting
- E. ACI 308.1 – Standard Specification for Curing Concrete
- F. ACI 318 Building Code Requirements for Structural Concrete
- G. ACI 350.1 – Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures
- H. ACI 355.2 – Qualifications of Post-Installed Mechanical Anchors in Concrete
- I. ACI 355.4 – Qualifications of Post-Installed Adhesive Anchors in Concrete
- J. ACI SP-66 – ACI Detailing Manual
- K. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- L. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

- M. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- N. ASTM A1064/A1064M – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain or Deformed, for Concrete
- O. ASTM C33/C33M - Specification for Concrete Aggregates
- P. ASTM C40/C40M – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
- Q. ASTM C88– Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- R. ASTM C94/C94M - Specification for Ready Mixed Concrete
- S. ASTM C131/C131M – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Abrasion Machine
- T. ASTM C150/C150M - Specification for Portland Cement
- U. ASTM C171/C171M - Standard Specification for Sheet Materials for Curing Concrete
- V. ASTM C260/C260M - Specification for Air Entraining Admixtures for Concrete
- W. ASTM C309 – Standard Specification for Liquid Membrane - Forming Compounds for Curing Concrete
- X. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- Y. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
- Z. ASTM C494/C494M - Specification for Chemical Admixtures for Concrete
- AA. ASTM C535– Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Abrasion Machine
- BB. ASTM C595/C595M - Specification for Blended Hydraulic Cements
- CC. ASTM C618/C618M - Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- DD. ASTM C877 - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
- EE. ASTM C881/C881M - Specification for Epoxy-Resin-Base Bonding Systems for Concrete
- FF. ASTM C887 - Standard Specification for Packaged, Dry, Combined Materials for Surface Bonding Mortar
- GG. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
- HH. ASTM C920 - Standard Specification for Elastomeric Joint Sealants
- II. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
- JJ. ASTM C989/C989M - Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
- KK. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- LL. ASTM C1260– Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

- MM. ASTM C1293– Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
- NN. ASTM C1478 - Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes, and Laterals
- OO. ASTM C1567– Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar Bar Method)
- PP. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal
- QQ. ASTM D1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing
- RR. ASTM D4101 - Standard Specification for Polypropylene Injection and Extrusion Materials
- SS. ASTM E329– Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
- TT. AWS D1.4/D1.4M – Structural Welding Code – Reinforcing Steel
- UU. Concrete Reinforcing Steel Institute - 10MSP, Manual of Standard Practice
- VV. Concrete Reinforcing Steel Institute - Placing Reinforcing Bars
- WW. Precast/Prestressed Concrete Institute (PCI) – Manual for Quality Control for Plants and Production of Structural Precast Concrete Products (MNL-116)
- XX. CSA Group – A23.4 Precast Concrete – Materials and Construction

1.4 DESIGN REQUIREMENTS

- A. All precast units shall be constructed with ship lap joints and of shapes and sizes as shown on the Drawings.
- B. Structural design calculations shall include the following loading conditions:
 - 1. Empty precast structure with all external loads at maximum groundwater elevation
 - 2. Precast structure full of liquid with no backfill (leak test condition for tanks)
 - 3. Lifting of precast units. Member design shall consider forces and distortions during curing, stripping, storage, transportation, and erection so that precast members are not overstressed or otherwise damaged.
- C. All base sections shall be designed with the floor slabs cast as an integral placement with the bottom wall section.
- D. Minimum 28 day compressive strength: $f_c' = 5,000$ psi.
- E. Reinforcing Steel:
 - 1. ASTM A615/A615M grade 60 deformed bars or ASTM A1064/A1064M welded wire fabric.
 - 2. Minimum reinforcing steel in all concrete sections shall be no less than 0.003 times the gross area of the concrete section.
- F. Concrete cover on reinforcing steel: 1½ inches minimum.
- G. The interior dimensions of the precast concrete structures shall be as shown on the Drawings. Walls, top slabs and base slabs shall be a minimum of 8” thick.
- H. The precast concrete structure shall be designed to support its own weight plus the following minimum superimposed vertical and lateral loads:
 - 1. Live load on top slab – 300 psf.

2. Lateral soil pressure - 95 pcf/vf. The top of the pressure diagram shall be assumed to originate at finish grade as shown on the drawings.
 3. Uniform live load lateral surcharge of 125 psf applied horizontally to the sides of the precast structure for a depth of 10 feet below finish grade.
 4. Interior liquid loading (tanks) – Design for the tank to be filled to the top with no backfill in place. Liquid density shall be assumed to be 63 pcf/vf
 5. Except where higher loads are specified herein, wastewater structures shall be designed for the minimum loads prescribed in ASTM C890.
- I. The precast concrete structure shall be designed to resist flotation:
1. A factor of safety of 1.15 shall be used against flotation based on weights of empty structure and soil directly over footing extensions and above the top slab (if any).
 2. Unless otherwise indicated on the Structural Drawings, the maximum groundwater level shall be assumed to be at finished grade.
 3. The base slab may be extended beyond the face of the wall to provide additional resistance to flotation.
 4. Unless otherwise indicated on the Drawings, additional cast-in-place concrete base slabs will not be permitted for flotation resistance.
 5. Frictional resistance shall not be permitted.
 6. Where the structure is composed of successive vertical segments, the weight of the segments shall be such as to provide the same factor of safety for buoyancy, or stainless steel mechanical connections shall be used to connect the segments together.
 7. The buoyant force acting on an object is equal to the weight of the volume of water that is displaced by the object. The actual weight of the same volume determines whether or not the object is buoyant.
 8. If the Engineer determines that the submitted buoyancy calculations are incorrect, the Engineer shall direct the Contractor to implement specific measures to counteract buoyancy to the Engineer's satisfaction. Any and all costs associated with such measures shall be borne entirely by the Contractor and shall be at no additional cost to the Owner.
- J. Segmented structures with joints shall be designed and installed for watertight joints. Joints shall be designed to transfer shear without continuous reinforcing steel. Provide waterstop sealants and external sealing bands in all joints.

1.5 SUBMITTALS

- A. Manufacturer's Data:
1. Submit manufacturer's specifications and instructions for all manufactured materials and products including hatches, sealants, sealing bands, dampproofing, pipe sleeves, flexible wall boots, anchorage hardware and other items. Include manufacturer's certifications and laboratory test reports as required.
 2. Submit the proposed erection procedure for precast units, sequence of erection, and required handling equipment.
- B. Shop Drawings:
1. Submit shop drawings showing complete information for the fabrication and installation of precast concrete units.

2. Submit layout drawings prepared and stamped by a Professional Engineer registered in the State of Connecticut. Drawings shall include member dimensions and cross sections, locations, sizes, types and details of reinforcement, including special reinforcement and lifting devices necessary for handling and erection.
3. Submit layout, dimensions, and identification of each precast unit corresponding to the sequence and procedure of installation. Indicate welded connections by AWS standard symbols. Provide details for all inserts, connections, and joints.
4. Submit location and details of anchorage devices that are to be embedded in the precast concrete sections or other concrete construction. Furnish templates if required for accurate placement.
5. Submit structural design calculations and buoyancy analysis demonstrating the structural integrity of all precast concrete units. Calculations and Drawings shall be prepared and stamped by a Professional Engineer registered in the State of Connecticut.
6. Submit Concrete Mix designs including test data that meets the criteria specified in ACI 301, Section 4. Mix design shall include:
 - a. Proportions for all ingredients, 28-day design compressive strength, water to cementitious materials ratio, admixture dosages, slump, and air content.
 - b. Cement Manufacturer's Certificates of conformance with ASTM C150/C150M taken during the last 90 days.
 - c. Supplementary Cementitious Materials: Source and test reports with certificates of conformance with ASTM C618 for fly ash and ASTM C989 for ground granulated blast furnace slag for actual material to be used in the Work taken during the last 90 days
 - d. Aggregate: data not older than 90 days, except test data for soundness, abrasion, alkali reactivity – not older than 12 months. Fine and coarse aggregate data shall include:
 - i. Sources
 - ii. Specific Gravity
 - iii. Sieve analyses per ASTM C33/C33M, including fineness modulus of fine aggregate
 - iv. Organic impurities for fine aggregate per ASTM C40/C40M
 - v. Potential alkali reactivity (except not required if a cement containing less than 0.60% alkalis is used, per ASTM C33/C33M), per ASTM C1260, ASTM C1293, or ASTM C1567
 - vi. Soundness per ASTM C88
 - vii. Abrasion for coarse aggregate per ASTM C131/C131M and ASTM C535
 - e. Product data and material safety data sheets for concrete admixtures.

- f. Test reports by testing agencies meeting ASTM E329:
 - i. Test data used to determine the standard deviation used for establishing the required average design strength, and test data documenting that the proposed concrete proportions will produce an average compressive strength equal or greater than the required average compressive strength, shall be from within the previous 12 months.
 - ii. Laboratory trial batch data shall be from with the previous 24 months.
7. Indicate locations of wall penetrations for pipes. All openings shall be cast-in-place at the manufacturing plant. Field coring of pipe penetrations shall not be allowed.
8. Submit past Project list with Owner contact information.

1.6 QUALITY ASSURANCE

- A. The manufacturer shall exhibit satisfactory performance on projects of similar magnitude under similar or equal service conditions for a period not less than five (5) years.
- B. Precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute (PCI) Plant Certification Program. Manufacturer shall be certified in Group C and CA products.
- C. The precast concrete manufacturing plant shall implement a Quality Control Plan and maintain a permanent Quality Control Manual outlining the quality control procedures used by the plant.
- D. Engineer (or Independent Testing Laboratory) may perform a plant inspection at any time during casting of precast concrete components during the construction period. General Contractor shall notify the Engineer a minimum of 14 days prior to the availability of specific precast components for inspection. After notification, Engineer will notify the General Contractor a minimum of 72 hours prior to the inspection.

1.7 WARRANTY

- A. The Precast Concrete manufacturer shall guarantee all precast concrete members for the following:
 1. Separation of joints or misalignment of adjacent units.
 2. Cracking, spalling or other concrete defects.
 3. Leakage through all joints between concrete sections and all members against infiltration of water through the concrete.
 4. The manufacturer shall repair or replace all defective work for a period of one year after the Date of Substantial Completion at no additional cost to the Owner.

1.8 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be inspected at the project site by the General Contractor for shipping damage at the time of delivery. All damaged materials shall be replaced by the Contractor at no additional cost to the Owner.

- B. Store precast concrete units at the project site to ensure against cracking, distortion, staining, or other physical damage, and so that markings are visible. Lift and support units at the designated lift points only.
- C. All precast concrete units shall be placed on supports such that they are stored off the ground.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. American Concrete (Superior Concrete, LLC), Auburn, ME
- B. Newstress Inc, Epsom, NH
- C. Unistress Corp, Pittsfield, MA
- D. Oldcastle Precast, Inc., Rehoboth, MA
- E. Oldcastle Precast, Inc, Avon, CT
- F. Blakeslee Prestress, Inc., Branford, CT
- G. United Concrete Products., Inc., Yalesville, CT
- H. J.P. Carrara & Sons, Inc., Middlebury, VT
- I. S.D. Ireland Concrete Construction Corp., Williston, VT
- J. William E. Dailey Precast, LLC, Shaftsbury, VT
- K. Olcastle Precast Building Systems, Selkirk, NY
- L. Strescon Limited, Saint John, New Brunswick, Canada
- M. Or equivalent

2.2 MATERIALS

- A. Concrete mix design shall conform to the following:
 - 1. Minimum compressive strength of concrete at 28 days (f'c) = 5000 psi.
 - 2. Maximum water/cement ratio = 0.45
 - 3. Cement:
 - a. Cement for all units shall be Type II Portland cement conforming to ASTM C150/C150M.
 - b. Blended cements: ASTM C595/595M. Do not use blended cements conforming to ASTM C595/595M if they contain cements conforming to ASTM C1157/C1157M.
 - c. Supplementary Cementitious Materials:
 - i. Ground Granulated Blast Furnace Slag: ASTM C989 - Grade 100 or 120.
 - ii. Fly Ash: ASTM C618/C618M - Type F
 - d. The proposed mix shall contain cementitious materials in the following proportions:
 - i. Portland Cement - No less than 75% of the total by weight.
 - ii. Ground Granulated Blast Furnace Slag - No greater than 50% of the total by weight.
 - iii. Fly Ash - No greater than 25% of the total by weight.
 - 4. Entrained air content of concrete: 6% ± 1.5%. Air entrainment admixture shall conform to ASTM C260/C260M.

5. Admixtures:
 - a. Low Range Water Reducer: MasterPozzolith 210 by Master BuildersBASF; WRDA with HYCOL by W.R. Grace Construction Products Division& Company; or equivalent meeting ASTM C494/C494M Type A.
 - b. High Range Water Reducer (superplasticiser): Rheobuild 1000 or Glenium 3000 NS by Master BuildersBASF; Daracem 100 or ADVA 140M by W.R. Grace & CompanyW.R. Grace; or equivalent meeting ASTM C494/C494M Type F.
 - c. Air entraining agent: MasterAir AE 200 by Master Builders, DAREX II AEA by W.R. Grace & Company; or equivalent meeting ASTM C260/C260M.
6. Coarse aggregate shall consist of a well graded crushed stone or a washed gravel conforming to the requirements of ASTM C33/C33M and the following requirements:

SIEVE	PERCENT PASSING			
	NO. 8 (3/8")	NO. 67 (3/4")	NO. 57 (1")	NO. 467 (1 1/2")
1-1/2 inch	-	-	100	95-100
1 inch	-	100	95-100	
3/4 inch	-	90-100	-	35-70
1/2 inch	100	-	25-60	
3/8 inch	85-100	20-55	-	10-30
No. 4	10-30	0-10	0-10	0-5
No. 8	0-10	0-5	0-5	
No. 16	0-5	-	-	
No. 50		-	-	

7. Fine aggregate shall consist of washed inert natural sand, free from mineral or other coatings, soft particles, clay, loam, organic or other deleterious materials conforming to the requirements of ASTM C33/C33M and the following requirements:

SIEVE NO.	PERCENT PASSING
4	95 to 100
8	80 to 100
16	50 to 85
30	25 to 60
50	5 to 30
100	0 to 10

8. Potable water.
- B. Reinforcing steel:
1. Bars: ASTM A615/A615M Grade 60; deformed new materials. Cold-bent in accordance with CRSI 10MSP

2. Welded wire fabric: ASTM A1064/A1064M.
 3. Tie wire: ASTM A1064/A1064M, annealed.
- C. Plates and inserts:
1. Plates:
 - a. Provide cast-in-place plates as shown on the Drawings. Plates shall be either:
 - i. ASTM A36/A36M. Hot dipped galvanized in accordance with ASTM A123/A123M or
 - ii. AISI Type 316 stainless steel.
 - b. Inserts:
 - i. Provide AISI Type 316 stainless steel inserts as required for lifting, connections, etc.
- D. Manhole Steps:
1. Provide manhole steps as shown on the Drawings.
 2. Steps shall be constructed of steel reinforced copolymer polypropylene. Steps shall conform to ASTM C478 and the polypropylene shall conform to ASTM D4101.
 3. The top surface shall have a molded non-slip surface
 4. Step widths shall be between 13.75 inches – 14 inches. Step projects from face of concrete shall be between 5 inches – 6 inches.
 5. Steps shall be able to support the following loads in accordance with ASTM C478:
 - a. Minimum pullout load of 300 pounds
 - b. Minimum vertical load of 800 pounds with a maximum permanent deflection of ½ inch
 6. Thoroughly clean all surfaces to be embedded with a suitable cleaning agent to ensure that the surfaces are free from all foreign matter such as dirt, oil and grease.
 7. All steps shall be cast into walls of the precast section so as to form a continuous ladder with a distance of 12-inches between steps. Step inserts may be cast into the walls if reviewed with No Exceptions Taken by the Engineer.
 8. Acceptable products:
 - a. Model ML-13-NCR by American Step Company, Inc.
 - b. Model P-14938 by Parson Environmental Products, Inc.
 - c. Model PS2-PF by M. A. Industries, Inc.
 - d. Or equal
- E. Pipe Openings:
1. Provide flexible rubber watertight connectors at all pipe penetrations in the precast concrete structure. Connector shall conform to ASTM C923.
 2. Connectors shall either be cast into the concrete base or fastened to the structure with stainless steel expansive sleeves.
 3. Pipes shall be fastened to the connector with stainless steel bands.
 4. Acceptable products:
 - a. Kor-N-Seal (106-406 Series) by Trelleborg Pipe Seals
 - b. PSX: Positive Seal by Press-Seal Corporation
 - c. Z-Lok Connector made by A-Loc Products Inc.

- d. Or equal
- F. Precast section joints:
 - 1. Provide rubber sealant and wraps at all precast concrete section joints.
 - 2. Rubber sealants:
 - a. Install solid, continuous flexible butyl rubber sealants in all joints to achieve watertight joints. Install a double row of joint sealants for every manhole joint.
 - b. Sealant shall conform to ASTM C990.
 - c. Sealant shall maintain stability at all temperatures and not shrink or harden over time.
 - d. Acceptable products:
 - i. Kent Seal No. 2 by Hamilton Kent
 - ii. RN 101 Ram-Nek Joint Sealant by Henry
 - iii. EZ-STIK or PRO_STIK Butyl Sealant by Press-Seal Corporation
 - iv. Conseal CS-102 (CS-202 when the temperature during installation is less than 30°F) by Concrete Sealants, Inc.
 - v. Or equal
 - 3. Joint Wrap:
 - a. Wraps shall consist of two layers: a butyl joint wrap layer (30 mil) and an EPDM rubber backing layer (45 mil).
 - b. Wraps shall be 12" wide.
 - c. Install solid, continuous flexible butyl rubber wraps around the exterior face of all joints to achieve watertight joints.
 - d. Wraps shall conform to ASTM C877 Type III.
 - e. Acceptable products:
 - i. EZ-WRAP by Press-Seal Corporation
 - ii. Con-Seal CS-212
 - iii. Or equal
- G. Liquid Asphalt Dampproofing:
 - 1. Apply a two coat waterborne emulsified-asphalt dampproofing system for all below grade exterior wall surfaces:
 - 2. First coat: Fiber free waterborne emulsified-asphalt dampproofing conforming to ASTM D1187/D1187M (Type 1) and ASTM D1227 (Type 3, Class I). Hydrocide 600 by Sonneborn Building Products - or equal.
 - 3. Second coat: Waterborne emulsified-asphalt dampproofing reinforced by long fibers conforming to ASTM D1187/D1187M (Type 1) and ASTM D1227 (Type 2, Class I). Hydrocide 700 by Sonneborn Building Products or equal.
 - 4. Hatches: Provide hatches as shown on the Drawings. Integral hatches are furnished under this Section, and specified in Specification Section 08305 "Special Doors".
- H. Concrete Repair Materials:
 - 1. Repair of random cracks (wet - presence of liquid or moisture):
 - a. Low viscosity polyurethane resin that expands and forms a closed cell foam when it comes in contact with water.

- b. All cracks that are wet (either damp or leaking) at the time of repair shall be repaired with a material that is specifically intended for wet repair as recommended by the manufacturer.
- c. Acceptable products:
 - i. SikaFix HH Hydrophilic by Sika Corporation
 - ii. Dural Aqua-Fil by Euclid Chemical Co.
 - iii. MasterInject 1210 IUG by Master Builders
 - iv. Or equivalent

PART 3 - EXECUTION

3.1 FORMWORK

- A. Forms for manufacturing precast concrete products shall be of the type and design consistent with industry standards and practices.
- B. Forms shall be capable of consistently providing uniform products and dimensions.
- C. Forms shall be constructed so that the forces and vibrations to which the forms will be subjected can cause no product damage

3.2 FABRICATION AND PLACING REINFORCEMENT

- A. Detailing and fabrication of reinforcement shall conform to the CRSI Code of Standard Practice unless otherwise indicated on the Drawings.
- B. Reinforcing steel bars shall be clean and free from loose mill scale and rust and from coatings that reduce bond.
- C. Place reinforcement of structural members on accessory bolsters and chairs. Accessories shall be stainless steel or have plastic tips.
- D. All reinforcing shall have adequate concrete cover as specified.
- E. Do not weld reinforcement unless the Engineer takes no exceptions in writing. When permitted, welding shall be in accordance with AWS D1.4/D1.4M.

3.3 PRODUCTION, CURING, FINISHING, REPAIRS AND STORAGE

- A. Production, curing and storage of the precast units shall conform to the provisions of the MNL 116.
- B. Production:
 - 1. Each precast concrete unit shall be an integral placement without any construction or cold joints. Base slabs shall be an integral placement with the bottom wall section.
 - 2. Structures shall be fabricated from the minimum number of precast sections in order to minimize the number of joints. Joints shall be located penetrations do not intersect joints.
- C. Tolerances: Fabricate precast units without exceeding the tolerances specified in MNL 116
 - a. Round, square and rectangular vertical type manhole and vault structures:
 - i. Interior width:
 - (1) Less than 48": +/- 7/16"
 - (2) 48" – 96": +/- 3/4"
 - (3) Greater than 96": +/- 1"
 - ii. Vertical wall width: -3/16", +1"

- iii. Top and bottom slab depth: $-3/16''$, $+1''$
- iv. Variation in length of opposite surfaces:
 - (1) Per foot of internal span: $\pm 1/8''$
 - (2) Span = 7' or less: $\pm 5/8''$
 - (3) Span > 7': $\pm 3/4''$
- v. Variation From Specified Plan End Squareness or Skew: $\pm 1/2''$
- vi. Offsets in Alignment of Adjacent Members at Any Joint: $\pm 1/4''$

D. Curing:

- 1. All exposed precast concrete shall be cured by either:
 - a. Moist curing (steam, ponding or application of burlap kept continuously wet)
 - b. Covering the exposed surface with polyethylene sheets
 - c. Covering the exposed concrete with membrane curing compounds
 - d. Application of steam. This method may only be used after the initial set of the concrete.
- 2. Alternate wetting and drying shall not be permitted

E. Finishing:

- 1. Unless otherwise indicated all surfaces shall be cast with an "As Cast" finish.
- 2. Small surface holes (up to $1/4$ inch diameter) caused by air bubbles will be accepted but no major imperfections, excessive honeycombing, sand streaks or other major defects shall be permitted.

F. Repairs of Defects at the Plant:

- 1. Minor defects:
 - a. Surface defects not impairing the functional use or expected life of a precast concrete product as determined by the Engineer of Record shall be considered minor defects.
 - b. Minor defects shall be repaired by any method that does not impair the product.
 - c. All repairs shall be made and identified prior to shipment to the Project site.
- 2. Major defects:
 - a. Defects in precast concrete products that impair the functional use or the expected life of products as determined by the Engineer shall be considered major defects.
 - b. All precast units with major defects shall be rejected and not delivered to the Project site

G. Storage:

- 1. Areas used for storage of products shall be firm enough and level enough to avoid causing damage to stored products.
- 2. Products shall be stored on level surfaces in a manner that will minimize damage caused by uneven bearing, improperly located dunnage blocks, stacking products too high or difficulty in handling.

3.4 HANDLING, AND TRANSPORTATION

- A. All precast concrete units shall be lifted using designated pick points and lifting inserts. Extreme caution shall be exercised so as not to damage the units during handling.
- B. Prior to shipment, all precast products shall be inspected by Plant personnel to assure design conformance, all defects have been repaired and all units have proper identification. Products not conforming to requirements shall be clearly labeled and the defects noted on the inspection report. Only products conforming to the requirements shall be shipped.
- C. Transportation:
 - 1. Precast concrete units shall be properly supported during transportation to minimize damage.
 - 2. Transport units in a position consistent with their shapes in order to avoid excessive stresses that may cause damage. Unique shipping instructions or special stacking may be required for irregularly shaped pieces.
 - 3. Do not transport units until they have been cured for a minimum of 5 days or have reached 75% of their 28 day design strength.

3.5 REPAIR OF SURFACE DEFECTS

- A. Form Tie Holes: After cleaned and thoroughly dampened, apply grout paint and fill holes solid with patching mortar.
- B. Air voids (bugholes): After cleaned and thoroughly dampened, apply grout paint and fill holes solid with patching mortar.

3.6 ERECTION OF PRECAST STRUCTURES

- A. Install all precast structures level and plumb to the elevations and in the locations shown on the Drawings. All precast concrete units shall be lifted using designated pick points and lifting inserts in accordance with the written instructions from the Precast Concrete supplier.
- B. Connect adjacent precast concrete units as required by the manufacturer. Install gaskets in all joints. All units shall fit tight to their adjacent units.
- C. Install solid, continuous flexible rubber wraps around the exterior face of all horizontal and vertical joints to achieve watertight joints. All wraps shall be installed in accordance with the manufacturer's recommendations.
- D. After erection is complete, all surface damages to the precast concrete units shall be properly repaired. All lifting inserts and holes shall be patched after final installation.

3.7 LIQUID ASPHALT DAMPPROOFING APPLICATION

- A. Apply dampproofing to the exterior surfaces all below grade precast concrete walls and on the top surface of below grade top slabs.
- B. Apply two coats in strict accordance with manufacturer's printed instructions and as specified herein. Clean and prepare surfaces as required.
- C. Do not apply dampproofing at temperatures below 40° F or when temperature is expected to fall below 40° F within 12 hours.
- D. Do not place backfill for at least 48 hours after application.
- E. All dampproofing materials spilled on adjacent structures shall be cleaned with a material recommended by the dampproofing manufacturer.

3.8 TESTING

A. General:

1. Perform leakage test on precast wetwell prior to backfilling.
2. All testing must be performed in the presence of the Engineer.
3. Suitably plug all pipes entering precast concrete tank and brace plugs to prevent blow out.

B. Leakage Test:

1. Leakage tests shall be performed in accordance with ACI 350.1 Section 2 – “Hydrostatic Tightness Test, for Open or Covered Containment Structures”. There shall be no measurable loss due to leakage.
2. The specified leakage test consists of: Part 1 Qualitative Criteria, and Part 2 Quantitative Criteria. See ACI 350.1 for required test preparation and procedures.
3. Structure shall be filled to the top with potable water furnished by the Contractor from a municipal water supply.
4. All leaks and areas where moisture can be picked up on a dry hand shall be repaired and eliminated by a method proposed by the Contractor and reviewed for information only by the Engineer. Repair of cracks shall be with the use of a pressure injection method. Use of surface applied overlays over the crack will not be permitted. All repairs to new concrete shall be at no additional cost to the Owner.
5. Retest after repairs are made.
6. Additional tests and repairs shall be performed until demonstrated compliance with the testing requirements.
7. Test water shall be disposed of by a method proposed by the Contractor and reviewed by the Engineer with no exceptions taken. All methods of disposal shall be in accordance with all Local, State and federal regulations.
8. Contractor shall dispose of water in accordance with all applicable local, State and Federal Regulations.

END OF SECTION

SECTION 05500METAL FABRICATIONSPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Structural steel shapes
- B. Steel lintels
- C. Other miscellaneous aluminum, steel and stainless steel fabrications
- D. Fasteners (concrete anchors and bolts)
- E. Surface preparation, shop coatings and galvanizing

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Steel lintels
- B. Concrete anchors

1.3 RELATED SECTIONS

- A. Section 01340 - Submittals
- B. Section 03300 - Cast-in-Place Concrete
- C. Section 09900 – Painting
- D. Section 09905 – Surface Preparation and Shop Coatings

1.4 REFERENCES

- A. ASTM A36/A36-05 - Specification for Carbon Structural Steel
- B. ASTM A48/A48M-03 - Specification for Gray Iron Castings
- C. ASTM A53/A53M-07 - Specification for Pipe, Steel, Black and Hot-dipped Zinc-coated welded and Seamless,
- D. ASTM A123/A123M-02 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron & Steel Products
- E. ASTM A153/A153M-05 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- F. ASTM A276-06 - Specification for Stainless Steel Bars and Shapes
- G. ASTM A307-07b - Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
- H. ASTM A325-07a - Specification for Structural Bolts, Steel, Heat treated 120/105 KSI minimum Tensile Strength
- I. ASTM A490-02 08a - Specifications for Heat-Treated Steel Structural Bolts, 150KSI Minimum Tensile Strength
- J. ASTM A500-07 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- K. ASTM A563-07a - Specification for Carbon and Alloy Steel Nuts.
- L. ASTM A992/A992M-06a - Standard Specification for Steel for Structural Shapes for Use in Building Framing

- M. ASTM A1011/A1011M-07- Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy, and High Strength Low Alloy with Improved Formability, and Ultra-High Strength
- N. ASTM B209-07 - Specification for Aluminum and Aluminum - Alloy Sheet & Plate
- O. ASTM B221-06 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes
- P. ASTM B308/B308M-02 - Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
- Q. ASTM B429-06 - Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
- R. ASTM C881/C881M-02 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete
- S. ASTM F436-07a - Specification for Hardened Steel Washers
- T. ASTM F593-02e2 - Specification for Stainless Steel Bolts, Hex Cap Screws and Studs
- U. ASTM F594-02 - Specification for Stainless Steel Nuts
- V. ASTM F1554-07a - Specification for Anchor Bolts, Steel 36, 55 and 105 KSI Yield Strength
- W. SSPC - Steel Structures Painting Council
- X. SSPC-SP1 - Solvent Cleaning
- Y. SSPC-SP2 - Hand Tool Cleaning
- Z. SSPC-SP3 - Power Tool Cleaning
- AA. SSPC-SP4 - Flame Cleaning of New Steel
- BB. SSPC-SP5 - White Metal Blast Cleaning
- CC. SSPC-SP6 - Commercial Blast Cleaning
- DD. SSPC-SP7 - Brush Off Blast Cleaning
- EE. SSPC-SP8 - Pickling
- FF. SSPC-SP10 - Near-White Blast Cleaning
- GG. Designation System for Aluminum Finishes
 - Aluminum Association
- HH. Aluminum Design Manual (2005)
 - Aluminum Association
- II. Aluminum Standards And Data (2006)
 - Aluminum Association
- JJ. Manual of Steel Construction (13th Edition)
 - American Institute of Steel Construction (AISC)
- KK. AWS D1.1/D1.1M-2006 Structural Welding Code-Steel
 - American Welding Society
- LL. AWS D1.2/D1.21M-2003 Structural Welding Code-Aluminum
 - American Welding Society,
- MM. Standard Amp 510-92 - Metal Stairs Manual (5th Edition)
 - National Association of Architectural Metal Manufacturers (NAAMM)

1.5 SUBMITTALS

- A. Submit complete shop drawings showing fabrication, welding, connections, erection, finishes, materials and dimensions including plans, elevations, sections and details of all metal fabrications and connections and location of item in structure. Photocopies of Contract Drawings, in whole or part, will not be accepted as shop drawings.
- B. Submit product data in accordance with the provisions of Section 01340.
- C. Submit certification from galvanizer stating that galvanizing is in accordance with Specifications.
- D. Submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificates shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

1.6 QUALITY ASSURANCE

- A. Conform to AISC Manual of Steel Construction for the design, fabrication and erection of structural steel.
- B. Conform to AWS Structural Welding Code - Steel for welding of structural steel.
- C. Conform to AWS Structural Welding Code - Aluminum for welding of structural aluminum.

1.7 COORDINATION

- A. The Contractor shall coordinate with the work of other Sections. Verify at the site both the dimensions and the work of other trades adjoining items before fabrication and installation of items herein specified.

1.8 FIELD MEASUREMENTS

- A. Field measurements shall be taken at the site to verify or supplement indicated dimensions and to insure proper fitting of all items.

1.9 DELIVERY, STORAGE, HANDLING

- A. Coordinate delivery of products.
- B. Protect products from damage prior to and after installation.
- C. Remove damaged material from the site.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL SHAPES

- A. Materials:
 - 1. Wide flange beams ("W" Shapes)-ASTM A992 (Grade 50)
 - 2. Channels, angles and other beams ("S" Shapes) - ASTM A36 (Grade 36)
 - 3. Plates-ASTM A572 (Grade 50)

- B. Finish: Hot-Dipped Galvanized: ASTM A153

2.2 STEEL LINTELS

- A. Material:
 - 1. Wide flange beams (“W” shapes) - ASTM A992
 - 2. Angles and channels - ASTM A36
 - 3. Bearing Plates - ASTM A572
- B. Finish: Hot-Dipped Galvanized (ASTM A123)

2.3 MISCELLANEOUS FABRICATIONS

- A. Includes other miscellaneous metal fabrications and assemblies shown on the Contract Drawings but not specified elsewhere
- B. Aluminum:
 - 1. Material: Alloy 6061-T6 (ASTM B209)
 - 2. Finish: Mill
- C. Structural Steel Shapes and Plates:
 - 1. Material: Wide flange beams (“W” shapes) (ASTM A992) or angles and channels (ASTM A36)
 - 2. Finish: Hot-Dipped Galvanized (ASTM A123)
- C. Welded and Seamless Steel Pipe ASTM A53, Grade B
- D. Cold Formed Welded and Seamless Steel Tubing: ASTM A500, Grade B
- E. Stainless Steel Shapes: AISI Type 316.
- F. Headed Studs: ASTM A325. Finish: Hot Dipped Galvanized ASTM A153

2.4 FASTENERS

- A. Concrete anchorage:
 - 1. Epoxy Anchors. ASTM C881. Non-expanding two component epoxy resin with AISC Type 316 Stainless Steel threaded rod with washer and nut. HIT RE500 by Hilti Fastening Systems; Chemset Capsule Series by Ramset Fastening Systems, or equivalent.
 - 2. Expansion Anchors - Stainless steel AISI Type 316 for galvanized and aluminum fabrications; cadmium plated for painted steel fabrications. Kwik-Bolt III by Hilti Fastening Systems or Tru Bolt Stud Anchor by Ramset Fastening System or equivalent.
 - 3. Anchor Rods
 - a. Material: ASTM F1554 Grade 55
 - b. Finish: Hot-Dipped Galvanized ASTM A153
- B. Bolted Joints:
 - 1. Aluminum Fabrications: Stainless Steel ASTM F593 & F594 Alloy Group 2 (Type 316)
 - 2. Steel Fabrications:
 - a. ASTM A325 (Painted) for Painted Steel Fabrications
 - b. ASTM A325 (Hot-Dipped Galvanized: ASTM A153) for Hot Dipped Galvanized Steel Fabrications.

3. Stainless Steel Fabrications: Stainless Steel ASTM F593& F594 Alloy Group 2 (Type 316).
- C. Provide all fasteners with nuts, flat washers and lock washers of the same material as the anchors or bolts. Provide beveled washers for sloped surfaces.
- D. Provide a minimum of 2 fasteners per connection.

PART 3 - EXECUTION

3.1 FABRICATION

- A. All miscellaneous metal members shall fit closely together and shall be straight and true, and the finished work shall be free from burrs, bends, twists, and open joints.
- B. Tolerances:
 1. Squareness: 1/8 inch maximum difference in diagonal measurements.
 2. Maximum Offset between faces: 1/16 inch.
 3. Maximum misalignment of adjacent members: 1/16 inch.
 4. Maximum Bow: 1/8 inch in 48 inches.
 5. Maximum Deviation From Plane: 1/16 inch in 48 inches.
- C. All holes, angles, supports, and braces shall be provided as required.
- D. Except as otherwise indicated on the drawings, gusset plates shall have a minimum thickness of 3/8-inch.
- E. Holes shall be made in steel members for attachment of wood blocking, nailers, etc. Holes shall be sized to suit the fasteners indicated on the drawings: where size and spacing are not indicated, holes shall be 9/16-inch diameter, at 3 feet o.c.
- F. Sheared and flame cut edges shall be true to line and free from rough corners and projections.
- G. Re-entrant cuts/corners shall be filleted to a radius of not less than 1/2 inch.
- H. Holes shall be punched, subpunched and reamed, or drilled in accordance with AISC "Specifications for Structural Steel." Holes shall not be made by flame cutting.
- I. Holes shall be 1/16 inch larger than the nominal bolt diameter, except holes for cast-in-place anchor bolts which shall be 5/16 inch larger than the nominal bolt diameter and as otherwise shown on the Drawings.
- J. The use of oversize or slotted holes not shown on the Drawings shall be subject to prior review by the Engineer.
- K. Bent plate shall be in accordance with AISC "Minimum Radius for Bending."
- L. Welding shall be done in a sequence which minimizes distortion and shrinkage.
- M. Fabrication holes, notches, etc. not required by nor shown on the Drawings shall be subject to prior review by the Engineer.

3.2 CONNECTIONS (GENERAL)

- A. Connections shall consist of the following:
 1. Steel Framing Connections: All steel framing connections not detailed on the Drawings shall be bolted connections designed by the fabricator subject to the provisions of the design drawings, specifications and the referenced AISC Specifications. All connections shall be designed to support one-half the total

uniform load capacity of the framing member as shown in Table 3-6 of the AISC Manual of Steel Construction. All connections shall be either standard double angle connections from Table 10-1 or standard shear plate connections from Table 10-9a of the AISC Manual of Steel Construction

- B. At the time of connecting, all bearing surfaces shall be free from loose or nonadherent rust, loose mill scale, oil, grease, dirt, mud, and any foreign matter, coating, or defect that adversely affects the connection.
- C. At the time of connecting, all faying surfaces at bolted connections shall be free from loose or nonadherent rust, loose mill scale, oil, grease, dirt, mud, and any foreign matter, coating, or defect that adversely affects the connection.

3.3 CONNECTIONS (BOLTED)

- A. "Snug-Tight" condition shall be defined as that tightness attained with a few impacts from an impact wrench or the full effort of an ironworker using an ordinary spud wrench to bring the connected elements into firm contact. All bolted connections shall be "Snug-Tight" unless indicated otherwise.
- B. Unfinished bolts shall conform to ASTM A307 and be tightened to a Snug-Tight condition. The nuts of all unfinished bolts shall be secured against loosening by denting the bolt threads with a chisel, or by other means reviewed and no exceptions taken by the Engineer.
- C. Epoxy anchors shall be tightened to 80% of the epoxy manufacturers recommended maximum torque using a calibrated torque wrench.
- D. High strength steel bolts and stainless steel bolts shall be tightened to a Snug-Tight condition with either spud wrenches or pneumatic impact wrenches.
- E. All bolts shall have washers between the tightened element and the structural member. Beveled washers shall be used where flange slope exceeds 1:20.
- F. The sockets used to tighten high strength bolts shall score or mark the nuts so that nuts have been tightened can be easily identified. High strength bolts or nuts once tightened shall not be loosened then re-used. Care shall be taken not to damage the threads of high strength bolts during installation. Joints shall be properly aligned and drifted and holes reamed, if required, to permit bolts to be slipped into place by hand. No burning is allowed for hole adjustment.

3.4 CONNECTIONS (SHOP AND FIELD WELDING OF FERROUS METALS)

- A. Welding shall be only for the connections and assemblages shown on the drawings or specified herein, and shall be performed in the shop, except where specifically noted to be done in the field.
- B. All welding shall be done only by certified welders using welding procedures and welding equipment. Welders employed on the work shall be experienced structural welders, previously qualified by tests as prescribed in the Structural Welding Code – Steel using the base metals and electrodes specified herein.
- C. Welding materials and workmanship shall conform to the Structural Welding Code - Steel. All welds shall be considered Prequalified if they conform to the Prequalified joints specified in Chapter 3 of the Structural Welding Code - Steel.

- D. Welding electrodes shall conform to the requirements of Structural Welding Code – Steel and shall be the E70XX series.
- E. Welding shall be by the manual shielded metal-arc process. If the fabricator wishes to use other processes, full details of materials, equipment, and procedures shall be submitted to and approved by the Engineer before any welding, other than as specified herein, is performed.
- F. All welds shall be free of undercut, unfilled craters, and cracks, and shall have smoothly faired contours. Flux and loose scale shall be removed from previous weld bead before succeeding bead is laid.
- G. All temporary (tack) welds shall meet all the specified requirements of the final welds. Tack welds that will be incorporated into the final weld shall be cleaned and thoroughly fused with final weld. Defective, cracked or broken tack welds shall be removed before final welding. Tack welds not incorporated into the final weld shall be removed.
- H. No welding shall be performed during the following weather conditions:
 - 1. Ambient temperature in the immediate vicinity of the weld is below 0°F,
 - 2. If the welded surfaces are wet or are exposed to rain or snow,
 - 3. High wind velocity. A temporary wind shelter may be used in order to reduce the wind directly exposed to the weld to a maximum of 5 mph,
 - 4. Other inclement conditions that will hamper good workmanship.
- I. All welds shall be marked by either submitting written records that indicate the location of welds made by each welder or by identifying the welds with a number, letter or symbol that corresponds to the individual welders.
- J. Welds other than those indicated on the design drawings may be used only if reviewed and no exceptions are taken by the Engineer.
- K. When welding is unsatisfactory or indicates inferior workmanship as determined by the Engineer, corrective measures shall be required. Where requirements prescribe the removal of part of the weld or a portion of the base metal, such removal shall be by machining, grinding, chipping or machining. All weld repairs shall be proposed by the General Contractor and reviewed by the Engineer with No Exceptions Taken. Defective or unsound welds shall be corrected either by removing and replacing the entire weld, or as follows:
 - 1. Overlap, excessive convexity or excessive reinforcement: Reduce to size by removal of excess weld metal.
 - 2. Cracks in weld or base metal: The extent of the crack shall be verified by acid etching, MT or PT methods. The crack and sound metal 2 inches beyond each end of the crack shall be removed and rewelded.
 - 3. Excessive concavity of weld or crater, Undersize welds, Undercutting: Clean and deposit additional weld metal.
 - 4. Incomplete fusion, excessive weld porosity or slag inclusions: Remove and replace the defective portions of weld.
 - 5. Removal of adjacent base metal during welding: Clean and reform base metal full size by depositing additional weld metal.
 - 6. Base metals distorted from welding: Straighten by mechanical means or by application of a limited amount of localized heat.

- L. Where work performed subsequent to the making of a deficient weld has rendered the weld inaccessible or has caused new conditions which would make the correction of the deficiency dangerous or ineffective, the original conditions shall be restored by removal of welds or members or both before making the necessary corrections, or else the deficiency shall be corrected by additional work according to a revised design approved by the Engineer.
- M. In the event that faulty welding or its removal for rewelding, shall so damage the base metal that in the judgment of the Engineer its retention is not in accordance with the intent of the Drawings and Specifications, the Contractor shall remove and replace the damaged material at no additional cost to the Owner.

3.5 ERECTION AND INSTALLATION

- A. Setting plates shall conform to the following:
 - 1. Top surface of plates shall be flat to within 0.025-inches in 12-inches.
 - 2. Top surface of plates shall be level to within 0.025-inches in 12-inches.
 - 3. Total of both out-of-level and cut-of-flatness shall not exceed 0.025-inches in 12-inches.
 - 4. Plates shall not be thinner than 1/4-inch, or smaller in any horizontal dimension than the base plate supported thereon.
- D. Grouting of column setting plates shall be performed under Section 03604 of the Specification. Structural grouting shall be non-shrink and conform to the requirements of Specification Section 03604. No load shall be applied to grout until five days after the plate has been grouted.
- E. All unmatched holes in shop assembly of field connections shall be reamed and the pieces match marked before disassembly. Drift pins shall be used only for bringing members into position and not to enlarge or distort holes. Any piece weakened by reaming to compensate for eccentricity to a point where the strength of the joint is impaired shall be rejected and a new and satisfactory piece shall be provided by the Contractor at his own expense. Slotted holes and washers shall be provided for truing up steel requiring accurate alignment.
- F. Camber of beams and girders shall be that indicated on the Drawings. Where no camber is indicated, any minor camber resulting from rolling or shop assembly shall be upward.
- G. The use of a gas cutting torch in the field for correcting fabrication errors will not be permitted upon any primary member of the structural framing. The use of a gas cutting torch will be permitted only on secondary members, and then only after the review and no exceptions taken by the Engineer.
- H. Layout, locate, level and plumb items, to be installed. Coordinate items to be installed in substrates.
- I. Drill and otherwise prepare substrates for fastening. Install non-shrink grout as required.
- J. Top edge of weir plates shall be set straight, true and accurately to the elevations indicated on the Drawings.
- K. Weir crests shall be adjusted level after filling the tanks with water.

- L. Coat surfaces of ferrous, non-ferrous metals including galvanized metals in contact with masonry, concrete, grout or dissimilar metals with Polyamide Epoxy Primer.
- M. Splice pipe rails in field with internal sleeves fastened with set screws on one end and welded on other.
- N. Install railing in accordance with manufacturers recommendations.

3.6 GALVANIZING

- A. Blast clean to near white metal in accordance with SSPC-SP10.
- B. Hot-dip galvanize fabricated items in accordance with ASTM A123 and hardware items in accordance with ASTM A153.
- C. Assembled and non-assembled steel as indicated on Drawing shall be galvanized.
- D. Galvanize items after assembly when possible.
- E. Thickness of galvanizing shall be as specified in ASTM A123 and A153 except coating shall not be less than 2 oz. (3.3 mils) per square foot.
- F. Galvanizing shall provide a visually acceptable substrate for applied coatings and shall be free of lumps, globules, sharp edges or heavy deposits which will interfere with intended use or a esthetic appearance of materials.
- G. After erection touch-up all damaged galvanized surfaces and field welds as follows:
 - 1. Surfaces to be reconditioned with zinc-rich paint shall be clean, dry, and free of oil, grease and corrosion.
 - 2. Areas to be repaired shall be power disc sanded to bright metal. To ensure that a smooth reconditioned coating can be effected, surface preparation shall extended into the undamaged galvanized coating.
 - 3. At galvanized surfaces, apply organic zinc repair paint complying with requirements of ASTM A780. Galvanizing repair paint shall have 65 percent zinc by weight.
 - 4. The paint shall be spray applied in multiple coats until a dry film thickness of 4-6 mils minimum has been achieved. A finish coat of aluminum paint shall be applied to provide a color blend with the surrounding galvanizing.
 - 5. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.
 - 6. Acceptable Repair Paint:
 - a. ZIRP by Duncan Galvanizing.
 - b. Tneme - Zinc by Tnemec.
 - c. Or equivalent.

3.7 SURFACE PREPARATION AND SHOP COATINGS

- A. Provide Surface Preparation and Shop Coatings in accordance with specification Section 09905, except for areas which to be field welded shall be protected with a shop coat of linseed oil.
- B. Shop coats shall be compatible with and made by the same manufacturer as the field top coats as specified in Section 09900. Contractor shall coordinate.
- C. After erection touch-up all abrasions and field welds with same material used on shop coating.

3.8 CLEANING

- A. Clean surfaces of all work of this section as well as the areas in the vicinity.

3.9 PROTECTION

- A. Protect installed work.
- B. Protect from splatter or debris from adjacent construction.
- C. Protect work from excess construction loading.

END OF SECTION

SECTION 07210BUILDING INSULATIONPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Perimeter and Underslab Insulation.

1.2 RELATED SECTIONS

- A. Section 01340 - Submittals
- B. Section 02200 - Earthwork
- C. Section 03300 - Cast-in-Place Concrete

1.3 REFERENCES

- A. ASTM C272 - Test Method for Water Absorption of Core Materials for Structural Sandwich Construction.
- B. ASTM C518 - Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter.
- C. ASTM D1621 - Test Method for Compressive Properties of Rigid Cellular Plastics.
- D. ASTM E96 - Test Method for Water Vapor Transmission of Materials.

1.4 SUBMITTALS

- A. Submit product data under provision of Section 01340.
- B. Submit manufacturer's installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in manufacturer's original unopened packaging.
- B. Identify contents, manufacture, brand name, thermal values, and applicable standards.
- C. Store materials in area protected from weather, and moisture.
- D. Remove damaged materials from site.

PART 2 - PRODUCTS2.1 MANUFACTURERS

- A. Perimeter and Under-slab Insulation
 - 1. Dow Building Solutions
 - 2. Owens-Corning
 - 3. Or equal

2.2 PERIMETER AND UNDER-SLAB INSULATION

- A. Insulation: Closed cell polystyrene foam board
- B. Aged "R" Value - "R" = 5.0 per inch, ASTM C518.
- C. Water Absorption - 0.1 percent, ASTM C272.
- D. Water Vapor Permeance - 1.1 perm (max) ASTM E96

- E. Compressive Strength - 25 pounds per square inch, ASTM D1621.
- F. Adhesive: Non asbestos, asphalt emulsion, trowel consistency.

PART 3 - EXECUTION

3.1 INSULATION

- A. Below Grade Insulation
 - 1. Install perimeter insulation at all frost walls and foundation walls, starting as indicated on the drawings, extending down to the top of the footing, unless indicated otherwise.
 - 2. Adhere insulation the foundation walls.
 - 3. Install under slab insulation where indicated on the drawings.

END OF SECTION

SECTION 07900JOINT SEALERSPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Preparing sealant substrate surfaces.
- B. Sealant and backing.

1.2 RELATED SECTIONS

- A. Section 01340 - Submittals
- B. Section 01710 - Project Cleaning
- C. Section 03300 - Cast-in-Place Concrete

1.3 REFERENCES

- A. ASTM C920 - Specification for Elastomeric Joint Sealant
- B. FS-TT-S-230 - Sealing Compound: Elastomeric Type, Single Component

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 01340.
- B. Submit color charts or samples.
- C. Submit manufacturer's installation instructions.
- D. Submit schedule of all items to be installed. Indicate intended use of each product.

1.5 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.

1.6 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.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate work in this Section with related sections.

1.8 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. S-6, Polyurethane Sealant: One component, moisture curing, non-staining, non-bleeding, non-sagging type; color as selected by Engineer; Sika-flex 1A as manufactured by Sika Corporation, Tremco or equal.
 - 1. Durability (Bond and Cohesion) ± 25 percent
 - 2. Service Temperature - 40 to 170 degrees F
 - 3. Shore A Hardness 40

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.

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. 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 1/2 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.

3.6 SCHEDULE

Sealant Type

Location

S-6

Interior Slab Isolation Joints

END OF SECTION

SECTION 08305SPECIAL DOORSPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Floor Hatches
- B. Safety Grating

1.2 RELATED SECTIONS

- A. Section 01340 - Shop Drawings
- B. Section 01710 - Project Cleaning
- C. Section 03420 - Precast Concrete Structures
- D. Section 05500 - Metal Fabrications

1.3 SUBMITTALS

- A. Submit product data under provision of Section 01340.
- B. Submit large scale details of all items furnished hereunder, and details of installation to the surrounding conditions.
- C. Submit manufactures specification and installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fabricated assemblies as job progress requires in the largest sections permitted, properly labeled for field erection.
- B. Store in original packaging on site under protective coverings and out of the way of normal construction activities. Provide special storage in accordance with the manufacturer's instructions and recommendations.
- C. Handle fabricated assemblies to prevent damage of any nature.

1.5 WARRANTIES

- A. Floor Hatches: Manufacturer shall guarantee against defects in material or workmanship for a period of five years.

PART 2 - PRODUCTS2.1 MANUFACTURERS

- A. Floor Hatches
 - 1. The Bilco Company
 - 2. Babcock-Davis Hatchways, Inc.
 - 3. Or equal.
- B. Safety Grating
 - 1. Safety grating shall be by Hatch Manufacturer.

2.2 FLOOR HATCHES

- A. 300 psf hatch:

1. Door leaf shall be 1/4-inch aluminum diamond pattern plate to withstand a live load of 300 pounds per square foot with a maximum deflection of 1/150th of the span. Channel frame shall be 1/4-inch aluminum with an anchor flange around the perimeter and have a minimum cross-section area of 7½ square inches. Door(s) shall be equipped with Type 316 stainless steel hardware including all parts of the latch and lifting mechanism assemblies, hold open arms and guides, and all brackets, hinges, pins and fasteners. Each leaf shall have two (2) compression spring operators enclosed in telescopic tubes shall be provided for smooth, easy and controlled door operation throughout the entire arc of opening and closing. Operation shall not be affected by temperature. The springs shall be of sufficient size to partially open the hatch when the latch is released. A Type 316 stainless steel snap lock with a gasketed cover plug and removable turn handle shall be provided. A 1-1/2" drainage coupling shall be located in the front right corner of the channel frame.

2.3 SAFETY GRATING

- A. Provide Hatch Safety grating, by Hatch Manufacturer at all new hatches .Grating shall be corrosion resistant fiberglass or aluminum and shall be rated for 300 PSF.
- C. Safety grating shall meet OSHA standard 1926.502 for fall protection.
- D. Grate shall be lockable with maximum grate openings not exceeding 5 inch by 5 inch, and maximum side clearance of 4 inches.
- E. Provide automatic hold open arm.
- F. Install per manufacturers recommendation.

2.4 FINISHES

- A. Mill finish aluminum.
- B. Polyamide epoxy (5 mils) or manufacturer's standard bituminous coating applied to exterior of the frame in contact with concrete.
- C. All coatings shall comply with Local, State and Federal regulations.

PART 3 - EXECUTION

3.1 FLOOR HATCH INSTALLATION

- A. Installation shall be in accordance with manufacturer's instructions.
- B. Coordinate the hatch installation with the drain piping.
- C. Cover and protect the installed hatches from splatter or debris and from damage or staining by adjacent work until accepted by the owner.

END OF SECTION

SECTION 09900PAININGPART 1 - GENERAL1.1 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. This Section also includes:
1. 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.
 2. Pipe, pump and valve identification markers.
 3. Motors, which are pre-finished, shall receive one top coat to provide a color matching the system color indicated in the pipe identification schedule.
 4. Paint all items modified or relocated in the existing facility.
- C. 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".
- D. 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 RELATED SECTIONS

- A. Section 01340 - Submittals
- B. Section 03300 - Cast-in-Place Concrete
- C. Section 08305 - Special Doors
- D. Section 09905 - Surface Preparation and Shop Coatings
- E. Division 11 – Equipment
- F. Section 13120 – Precast Concrete Building
- G. Division 15 - Mechanical
- H. Division 16 - Electrical

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. 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.

1.4 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.

1.5 QUALITY ASSURANCE

- A. 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 his unwillingness to use same, or his 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.
- B. Before purchasing materials for the work, the Contractor shall submit to the Engineer a list of the products he proposes to use, and the list shall be reviewed by the Engineer and no exceptions taken and reviewed by him before commitment for materials is made.
- C. Materials selected for coating systems for each type of surface shall be the products of a single manufacturer.
- D. 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
- E. 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.
- F. Paints submitted shall meet all Federal and State regulations pertaining to Volatile Organic Compounds (VOC) compliance, and be in accordance with OTC 2005 Standards.
- G. 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.

1.6 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.

1.7 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.

1.8 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

2.1 MANUFACTURERS (PAINT)

- A. Tnemec Company, Inc.
- B. Sherwin Williams
- C. PPG

2.2 MATERIALS

- A. Refer to the paint schedule for specific products and application.

2.3 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 interior or exterior wood and 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.

2.4 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. 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.
- B. 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.
- C. 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.

3.3 APPLICATION

- A. Workmanship:
 - 1. Employ skilled workmen to insure 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 and varnishes 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. Apply stain by brush. Cover surfaces with a uniform coat and wipe off if required.
 - d. 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. Apply one coat of metal primer, of the types specified hereunder, and one coat of flat black metal enamel, to the surfaces of all ductwork behind grilles, for a distance of 18 inches.

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 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
METALS				
Submerged Ferrous Metals	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
All portions of submerged metals subjected to UV Exposure shall receive the additional Polyurethane finish coat indicated:				Tnemec Series 73 Endura-shield at 3 to 4 mils OR SW Acrolon 218 HS Acrylic Polyurethane
Weather Exposed Ferrous Metal Piping and Equipment Specified to be Shop Primed in Their Respective Sections	SHOP	SHOP PRIME	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
Enclosed Ferrous Metal Piping and Equipment	SHOP	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	SHOP	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 73 Endura-shield at 3 to 4 mils OR SW Acrolon 218 HS Acrylic Polyurethane
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

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. Painting of the piping system shall include all ferrous valves, levers, valve handles, fittings, stands, supports, hangers, pumps and appurtenances.
5. Paint motors for color coordination.
6. 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.

3.8 PIPING IDENTIFICATION SCHEDULE

- A. All pipes, whether concealed or exposed to view shall be painted a separate color as selected by the engineer. For insulated pipes, only the insulation shall be painted.
- B. Markers shall be corrosion resistant laminated plastic bound to the pipes with nylon fasteners or shall be "coil-fit." Pipes with diameters less than 1-1/4 inch shall have marker hung from pipe with nylon fasteners.
- C. 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

- D. Adjacent to each marker there shall be an arrow indicating flow direction.
- E. 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.
- F. 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.
- G. Refer to Specification Sections 11000 for Equipment and Valve Identification requirements.
- H. 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.

- I. Wall supported pipe hangers consisting of brackets, standoffs, etc., shall be painted with the same color as that of the wall.
- J. Ceiling/roof supported pipe hangers consisting of thread rods, beam clamps, etc., shall be painted with the same color as that of the ceiling.
- K. Floor supported pipes consisting of stanchions shall be painted with same color as that of the pipe.

END OF SECTION

SECTION 09905SURFACE PREPARATION AND SHOP 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 RELATED SECTIONS

- A. Section 01340 - Submittals
- B. Section 05500 - Metal Fabrications
- C. Section 08305 - Special Doors
- D. Section 09900 - Painting
- E. Division 11 - Equipment - all applicable sections
- F. Division 15 - Mechanical - all applicable sections
- G. Division 16 - Electrical - all applicable sections

1.3 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.

1.4 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.

1.5 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.

1.6 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.

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 can not 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

SURFACE PREPARATION AND SHOP COATINGS

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 Epoxolime 11 3 to 5 mils
Ferrous Metals in contact with or embedded in concrete or masonry	SSPC-SP6 Commercial Blast Cleaning	Series 66HS Epoxolime 11 3 to 5 mils
All Other Weather Exposed and Enclosed Ferrous Metals, including steel frames, overhead door, steel lintels and bollards	SSPC-SP6 Commercial Blast Cleaning	Series 1Omnithane 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

SURFACE PREPARATION AND SHOP COATINGS

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 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. Equipment Startup, Certification and Operator Training are specified in Section 01800.
 - 3. Site work is specified in Division 2.
 - 4. Concrete and grout are specified in Division 3.
 - 5. Field painting is specified in Section 09900.
 - 6. Surface Preparation and Shop Coatings are specified in Section 09905
 - 7. Controls and Instrumentation are specified in Division 13.
 - 8. Pipe, plumbing, and mechanical work are specified in Division 15.
 - 9. 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. Substitute or "or-equal" equipment will be allowed only when indicated.
- C. Certificates, patents, licenses or other required legalities, when applicable, are specified in each Section of this Division.
- D. Manufacturer's names listed in "Acceptable Manufacturers" section of each specification are intended to indicate the type and quality of materials desired. Where the words "or equivalent" are indicated other manufacturers of equal quality, that comply fully with the specifications, are allowed. Where the words "or equivalent" are not included, the Contractor must provide equipment in compliance with the specifications that is manufactured from the listed manufacturers.
- E. 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.
- F. 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.

G. 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 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.

1.4 SEISMIC CONTROL

NOT USED.

1.5 GUARANTEE/WARRANTIES

- A. The Contractor shall provide the Owner with a Guarantee/ Warranty for the entire project in accordance with Article 7.17 (Contractor's General Warranty and Guarantee) and Article 15.08 (Correction Period), and as referenced, of the General Conditions (Section 00700) 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. Coat all machined surfaces subject to corrosion with an easily removable rust preventive compound prior to shipment.
- B. Ship fabricated assemblies in the largest sections permitted by carrier regulations, properly labeled for field erection.
- C. Deliver equipment in manufacturer's original, unopened and undamaged packages, unless mounted on equipment assembly.
- D. Contractor shall store and maintain all equipment in strict accordance with the manufacturer's written short term and long term storage requirements.
- E. 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
- F. 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 wetwell. 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 bolts shall be suitable size for the intended purpose, with direct input from the equipment or product manufacturer. In no case shall anchor bolt size be less than 3/8" diameter.

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.

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. 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.
- D. 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. Explosion-proof motors shall comply with all requirements of Class I, Division 1, Group D, hazardous locations as defined by the National Electrical Code and with all other safety codes pertaining thereto. Explosion proof motors shall be rated explosion proof for continuous in air duty.
 - 5. 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.
 - 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.
 - 6. 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, rated for Class I/ Division 2 Group C and D locations, or rated TEFC meeting the requirements specified below.
 - i. TEFC motors for use in hazardous locations shall be non-sparking

- type (brushless) with non-sparking cooling fans.
- 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 locations.
7. 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	2-Pole	4-pole	6-Pole	2-Pole	4-pole	6-Pole
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

- E. General Design of Motors
1. Motors shall comply with the latest NEMA Standards for Motors and Generators, unless otherwise specified.
 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.
- F. 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 pigtailed 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.
- G. 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.
- H. 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.
- I. 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.

J. 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.

K. Premium Efficiency Motors for Use with Variable Frequency Drives

1. Motors other than inverter duty rated type intended for use on variable frequency drive equipment shall have an insulation system that shall be inverter grade to meet NEMA MG1-1998, part 31.4.4.2.A., Class Insulation system with a Class B rise at a 1.15 service factor. Motors shall be wound with inverter duty wire and shall be multidipped and baked in a polyester, Class H varnish. Nameplate on motor shall be stamped indicating motor is certified for use with VFD's.

L. Inverter Duty Rated Motors

1. Motors which are rated for inverter duty shall be furnished and installed for all applications where used with variable frequency drive equipment.
2. Motor shall be suitable for operation over entire speed range indicated without causing motor overheating at any condition.
3. Forced ventilation type inverter duty rated motors with a separate external continuously operating fan shall not be acceptable.
4. Motors installed in Division 1 hazardous (classified) location shall be identified as acceptable for variable speed when used in Division 1 locations.
5. Motor shall have Class F insulation with a Class B temperature rise and shall be motor nameplated, stamped and labeled as Inverter Duty Rated.
6. Motors shall be designed with a 1.0 service factor (non-sinewave power) and 40°C ambient conditions per NEMA MG1-1998, part 31.3.7.
7. Motor shall be wound with inverter duty wire and phase paper and shall be multidipped and baked in polyester, Class H varnish.

M. 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.

2.5 SCR CONTROLLERS

- A. Each SCR controller shall be a completely solid state assembly consisting of an electronic switching amplifier, silicon controlled full wave rectifier and associated circuitry.
- B. Bridge and gate trigger circuitry shall employ printed circuit boards.
- C. Any required power transformers shall be supplied as appropriate.
- D. The SCR units shall be heavy duty type suitable for handling the full current rating of the motors and brief acceleration current.
- E. The assembly shall be mounted on a heat sink but insulated therefrom.
- F. Power supply to the SCR controllers shall be 115 volts, single phase, 60 Hz.

- G. Each unit shall be factory wired and tested with all leads brought out to terminal strips to facilitate connections to the motors and local control stations.
- H. Each SCR unit shall include the following features:
 - 1. Full wave rectification.
 - 2. Power cube containing all power semi-conductors in a single component.
 - 3. Armature contactor with auxiliary normally open and normally closed contacts.
 - 4. Circuit breaker to provide overload protection.
 - 5. Surge suppressers to protect semi-conductors from line surges and transients.
 - 6. Adjustable current limit.
 - 7. Adjustable IR compensation.
 - 8. Voltage level and current capacities shall meet the requirements of the connected equipment (i.e. 90V DC output for 90V DC motors).

2.6 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.

2.7 SPARE PARTS AND SPECIAL TOOLS

- A. For each type of equipment furnished by him, 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. Tools shall be high-grade, smooth, forged, alloy, tool steel. Grease guns shall be lever type.
- B. 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.
- C. 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.
- D. Spare parts shall be appropriately labeled and containerized, and shall be properly packaged for long-term storage.

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. 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.
 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.
- D. Process Isolator (Diaphragm Ring Seal): As indicated on the Drawings
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 ½” 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
- E. Gauges Assemblies shall be manufactured by:
 - 1. Ametek U.S. Gauge Division
 - 2. Ashcroft
 - 3. Terrice
 - 4. or equal.
- F. 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 TAGS

- A. All new process equipment and valves shall be identified by a color coded equipment/valve tag, provided and installed by the Contractor. Contractor shall submit a complete list of proposed Identification Tag information and it shall be reviewed by the Engineer and Owner and revised as indicated. In general, tag information shall match the information provided on the Drawings.
- B. 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 his 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.
 5. All equipment found defective by the Engineer shall be replaced by the Contractor at no expense to the Owner.

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.

END OF SECTION

SECTION 11310PUMPS - GENERALPART 1 - GENERAL1.1 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. **This includes two installed pumps and one complete spare pump.**
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. 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.

1.4 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 PUMPING SYSTEM

- A. General:
 1. Pump:
 - a. Pump type and use specified in Pump Schedule in this Section.
 - b. Pump shall be suitable for intended purpose as specified and as shown on Drawings.
 - c. Pumps designated for a certain function shall be supplied by same manufacturer.
 - d. Pumps for all functions need not be supplied by the same manufacturer.
 - e. All parts shall be designed and proportioned to have liberal strength, stability and stiffness to perform required function.
 - f. Provide ample room and fittings for inspection repairs and adjustments.
 - g. Pump base accurately aligned, sized and rigidly anchored into position in accordance with Drawings.
 - h. 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.
 - i. Provide adaptor flanges, as necessary, to match piping system.
 - j. 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.
 - f. Unless otherwise specified, motors shall be squirrel-cage, induction, shell-type design housed with oil-filled or air-filled water tight chamber NEMA Design B. Refer to Section 11319 for additional information.
 - g. Motors for submersible pumps shall be as specified in their respective sections.
3. Mechanical Seals (unless otherwise indicated):
 - a. General:
 - i. 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.
 - ii. Seal wearing face materials shall be solid construction only; no overlays, deposited castings or sprayed on coatings are permitted.
 - iii. Seal face materials shall be as specified below.
 - iv. Elastomeric parts such as O-rings, friction rings, etc. shall be made of fluorocarbon (Viton, Fluorel, Kalrez, Kel-F, etc.), unless otherwise specified.
 - v. Metal hardware shall be constructed of 316 SS.
 - vi. 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.
 - vii. Acceptable Manufacturers shall be:
 - (1) John Crane
 - (2) A. W. Chesterton Company
 - (3) or equal.
 - b. Seal Arrangements:
 - i. Seals for submersible pumps shall be as specified in the respective section.
4. Gauges:
 - a. Provide one suction gauge and one discharge gauge per pump, unless otherwise specified. Gauges shall be provided in accordance with Section 11000.
5. Lifting Cable:
 - a. Each pump shall be equipped with a stainless steel lifting cable of adequate length and lifting capacity for the pumps supplied. Terminate

- upper end of cable with a swag ball end for easy connection to the portable hoist.
6. Surface Preparation and Shop Coatings
 - a. Provide surface preparation and shop coatings in accordance with Specification Section 09905.
 7. 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. Wastewater Pumps: SECTION 11319
 1. Location: Cider Mill Pump Station wetwell.
 2. Function: Pump raw wastewater.
 3. Number of Units: **Three (3) (SP-1, SP-2 installed and one complete spare)**
 4. Type: Submersible, non-clog, centrifugal, Explosion-Proof Rated.
 5. Capacity: Each pump shall be capable of meeting the following operating conditions:
 1. 200 GPM @ 82-ft TDH with a minimum efficiency rating of 60%;
 2. Minimum shut-off head of 112 feet;
 3. Pumps shall be capable of pumping 600 GPM @ 66-ft TDH without cavitation or motor over load.
 6. RPM: 1800 RPM nominal.
 7. Seals: Refer to Section 11319.
 8. Drive: Variable frequency drives (provided under Division 16).
 9. Motor: 14 HP, 230 V, 3 Ø, 60 Hz.
 10. Control: Control shall be as specified in Section 11319 and 13440.
 11. Remarks: 4-inch discharge base elbow.

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 11319SUBMERSIBLE NON-CLOG CENTRIFUGAL PUMPSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish, install and test **three (two installed and one spare)** 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:
 - 1. Additional requirements are specified in Sections 01800, 11000 and 11310.
 - 2. General Requirements are specified Division 1.
 - 3. Concrete and grout are specified in Division 3.
 - 4. Metals are specified in Division 5.
 - 5. Surface Preparation, Shop and Field Coatings are specified in Division 9.
 - 6. General Pump System Requirements and Pump Schedule are specified in Section 11310.
 - 7. Instrumentation and Controls are specified in Division 13.
 - 8. Lifting hoist is specified in Division 14.
 - 9. Pipe, fittings and valves are specified in Division 15.
 - 10. Electrical is specified in Division 16.
- C. 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.

1.2 QUALITY ASSURANCE

- A. Qualifications of the Manufacturer:
 - 1. The pumps complete with all appurtenances forms an integrated system, and as such shall be supplied by one pump manufacturer who shall provide all the equipment and appurtenances, regardless of manufacturer. The Contractor shall be responsible for the satisfactory operation of the entire system.
- B. Acceptable Manufacturers:
 - 1. ABS Sulzer USA, Meriden, CT.
 - 2. No equivalent.

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.
6. Pumping units shall draw treated sewage effluent from a wet well and discharge into as specified in Section 11310.

B. Pump Support System

1. Pumps shall be mounted on a substantial guide rail system, with slide away coupling base/discharge elbow.
2. The lower guide holders shall be integral with the discharge connection and shall be anchored to the wet well floor by means of stainless steel anchors.
3. Pump base accurately aligned, sized, and rigidly anchored in position in accordance with the manufacturer's requirements and recommendations and allow for complete removal of each pump.
4. Sealing of pump to discharge connection shall be by means of metal to metal contact.
5. No portion of the pump shall bear directly on the floor.
6. There shall be two non-sparking guide rails per pump which shall be a minimum of 2-inch diameter stainless steel pipe.
7. Slide-away coupling shall be designed so that when pump is idle, it may be removed for service or inspection and then returned to service without entering the wet well to unbolt or unlock the connection between the pump and piping.

C. Submersible Non-Clog Sewage Pumps: The submersible non-clog sewage pumps shall be capable of pumping wastewater at the conditions indicated in the pump schedule and shall conform to the requirements specified. The pump shall have a wide suction and shall easily pass 3-inch solids or stringy matter.

D. Pump Casing:

1. Constructed of gray cast iron, Class 30 (ASTM A48) of ample thickness, capable of prolonged resistance to the abrasive action of solids or foreign matter contained in the liquid passing through the pump.
2. Supply hardened casing wear ring in cast iron or stainless steel material.

E. Discharge Nozzles: Minimum size and type indicated in the Pump Schedule.

F. Impeller:

1. The submersible non-clog sewage pump impeller shall be enclosed, non-clog, symmetrical, dynamically balanced with two vanes made of gray cast iron, Class 30 (ASTM A48).
2. Impeller vanes shall have a well rounded leading edge and thick hydrofoil shape and the waterways shall be smooth contours and well-rounded entrances.

3. The impeller hub shall not have ports for the reduction of thrust on the impeller.
 4. Impellers shall be key seated and securely attached to shaft by a streamlined locknut or equally efficient method, capable of withstanding a pump reversal to full runaway speed, but still permit easy removal.
 5. Supply impeller wear ring.
- G. Shaft: The pump-motor shaft shall be stainless steel, accurately machined.
- H. Seal (See Section 11310): The pump shaft seal shall be of the double mechanical type, with pump seal leak detection system as specified hereinafter.
- I. Motor:
1. Submersible non-clog sewage pump motor ratings shall be as specified in the preceding Pump Schedule, Section 11310.
 2. The pump motor shall be a NEMA B design, induction type with a squirrelcage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing.
 3. The motor shall be designed for variable speed duty handling pumped media of 40°C (104°F) and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum.
 4. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel.
 5. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomer compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding post permanently affixed to a terminal board.
 6. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise no to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.
 7. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
 8. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.
 9. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove

ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces

10. The motor shall be fitted with heavy lifting eyes, each capable of supporting the entire weight of the pump and motor.
 11. An electric sensing probe shall be mounted in the seal chamber, and be connected to a red signal light on the control panel, to detect any water leakage past the lower seal.
 12. A heat sensor thermostat shall protect motor against excess heat in compliance with its U.L. rating. Sensor shall reset automatically at the motor when motor cools. Heat sensor overload alarm light shall be manually reset at the Control Panel.
 13. Controls are specified in Section 13440. Refer to the Instrumentation and Electrical Drawings.
 - a. The pump system supplier shall provide the necessary relays and devices for monitoring, alarming and shutdown of the pumps based on seal chamber leak or motor excessive heat. Relays shall be furnished to the instrumentation system supplier under Section 13440 for installation by them in the pump control panel. Refer to the electrical drawings for control wiring diagrams and details
- J. Spare Parts:
1. Spare parts shall be delivered at the same time as the equipment to which they pertain.
 2. The contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
 3. Parts shall be packaged in individual suitable containers labeled with the part number, name and quantity.
 4. Spare parts shall include:
 - a. One set of hardened wear rings.
 - b. Any special tools required to service the equipment.

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 13120

PRECAST CONCRETE BUILDING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. A factory cast precast concrete building shall be supplied in accordance with project plans and specifications. The Precast building shall be delivered to the jobsite by the Building Manufacturer on flatbed trailer and installed by the precast manufacturer. The building manufacturer shall provide all lifting hardware that is needed to off-load and safely set the building in place on cast-in-place concrete supplied foundation and/or footing walls as noted on the plans. Refer to Contract Drawings for dimension requirements.

1.2 QUALITY ASSURANCE

- A. American Concrete Institute
 1. ACI-318-14, "Building Code Requirements for Reinforced Concrete".
- B. American Society for Testing and Materials
 1. ASTM C150 Portland Cement
 2. ASTM C33 Concrete Aggregates
 3. ASTM C260 Air-Entraining Admixtures for Concrete
 4. ASTM A185 Steel Welded Wire Fabric for Concrete Reinforcement
 5. ASTM C494 Chemical Admixtures for Concrete
 6. ASTM A706 Deformed and Weldable Steel Bars for Concrete Reinforcement
- C. ANSI/ASCE-7-10 "Building code requirement for minimum design loads in buildings and other structures".
- D. International building code (2012 Edition) 2012 IECC, State of Connecticut 2016 amendments/ supplements.
- E. Concrete reinforcing institute, "Manual of Standard Practice".
- F. Fabricator must be producer member of NPCA and PCI.
- G. Building fabricator must have a minimum of 10 years' experience manufacturing monolithic precast concrete buildings.
- H. CT State Modular Manufactures Certification for building code compliance and 3rd party review / certification.
- I. The building shall be manufactured by:
 1. United Concrete Products, Yalesville, CT.
 2. Shea Concrete, Amesbury, MA.
 3. Or equal.

1.3 DESIGN REQUIREMENTS

- A. Structural design calculations required and sealed by a professional engineer licensed to practice in the state where the project is located.
- B. The building shall be designed to meet the following load requirements:
 1. Roof Live Load – 35 psf
 2. Floor Live Load – 250 psf
 3. Wall Wind Load (130 mph) – 45 psf

4. Snow Load – 55 psf

- C. Building shall be constructed of steel-reinforced concrete. Floors and walls shall be produced as a single component when applicable. Concrete roof shall be attached to walls with welded connections with water stop sealant between surfaces. Roof shall extend past walls by 2". All wall corners to be monolithic construction. Panelized wall systems will not be considered as equal.
- D. The building shall have a minimum 8-inch average floor thickness, 6-inch average roof thickness and 4-inch walls.
- E. The building exterior / interior finishes, doors and building accessories as specified herein shall be factory installed at manufacturer's facility and shipped as completed / labeled unit. Some field assembly will be allowed if the building cannot be shipped in one piece.

1.4 SUBMITTALS

- A. Full set of shop drawings, calculations, submittals and bill of materials shall be submitted for acceptance.
- B. Coordinate all required building penetrations with the contract drawings.
- C. Close documents to include O&M manual and Warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete: Steel-reinforced, 5000 PSI minimum 28-day compressive strength, air-entrained (ASTM C260).
- B. Portland cement shall be Type III per ASTM specifications.
- C. Fine aggregate shall consist of natural sand per ASTM specifications.
- D. Coarse aggregate shall consist of ½" max well graded crushed stone per ASTM specifications.
- E. Reinforcing Steel: ASTM A615, grade 60 unless otherwise specified.
- F. Welded wire fabric shall meet ASTM specifications.
- G. All reinforcement shall be free of loose rust, oil or other items that may reduce bond. If present this material must be removed before placement.
- H. Supports for reinforcement shall be chairs, wheels or other apparatus for spacing and securing reinforcing.
- I. Caulking: Joints between walls and roof shall be caulked on the exterior and interior surface. Caulking shall be Demonic elastic sealant or equal.

2.2 ACCESSORIES

- A. Doors and Frames:
 - 1. Doors and frames shall be extruded Aluminum Alloy 6063-T5 as listed below:
 - a. (2) 3'-0" x 7'-0" x 1-3/4"
 - b. (2) 6'-0" x 7'-0" x 1-3/4" double doors
 - 2. Door stiles shall be fabricated of tubular aluminum with no exposed seams. The wall thickness shall not be less than 0.125 exposed seams. The wall thickness shall not be less than 0.125 inch. Top and bottom rails are held in position by dove tailed type clips and tension rods running the full length of the rails. The rods are to be fixed with stainless steel plates and lock nuts.

3. Hardware reinforcements on doors and frames shall be completely concealed and fastened in place with concealed type attachments.
 4. Door and frame finish shall be Class I finish, AA-M12-C22-A42 color anodized. Color to be selected by the Owner.
- B. Door Hardware:
1. Hinges: Hager Model #1191 with non-removable pin 4½" x 4½", stainless steel, 3 per door, or equal.
 2. Lock Set: Mortise with removable small format core coordinated and keyed to the Towns system.
 3. Exit Devices: 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.
 4. Closers: Cush-n-stop arms 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.
 5. Astragal: A4441/68R, or equal.
 6. Threshold: National Guard Products #B-97 or equal.
 7. Norton Series 8501 or equal.
 8. Drip Cap: National Guard 15D72, or equal.

2.3 FINISHES

- A. Refer to full typical details for pre-fabricated building construction on the contract drawings. Coordinate all required penetrations.
- B. Interior of Building: Walls to receive 2 coats of clear thorseal. Floors to receive clear concrete sealer.
- C. Exterior of building walls: To receive damproofing, 2" R-max rigid insulation with foil taped joints, 5/8-inch pressure treated plywood sheathing, hydrogap house wrap and vinyl cedar impressions, color selected by the Owner.
 1. Building supplier shall coordinate all exterior mounting requirements with the contract drawings and provide appropriately sized azek board (trimmed with j-channels) at all lights, fans, louvers, electrical panels, and other exterior mounted equipment locations.
 2. Provide removable hinged and lockable access door at bypass connection.
 3. Provide two 2'-6" wide faux aluminum windows and vinyl shutters.
 4. All trim and soffit materials shall be PVC with aluminum vents. Soffit and roof shall overhang building by 1-foot.
 5. All flashing shall be aluminum.
 6. Colors for all paint, trim, roofing and cedar impression shall be selected by the Owner.
- D. Exterior building roof: Install 3" rigid R-max insulation above concrete roof. Install pre-fabricated trusses (12/6 slope), 3/4" CDX plywood sheathing, full coverage ice and water barrier and 30-year architectural shingles with ridge vent.

PART 3 - WARRANTY

3.1 WARRANTIES

- A. Building accessions and components shall be warranted for one year from date of installation.
- B. The precast concrete structure shall be free of any defects / deterioration for 20 years.
- C. The asphalt shingle roof shall be warrantied for 30 years, materials and installation.

END OF SECTION

SECTION 13440INSTRUMENTATION AND PROCESS CONTROLPART 1 - GENERAL1.1 DESCRIPTION

A. General Requirements and Definitions:

1. A single System Integrator shall furnish all services and equipment as specified herein and in the following Specification sections:

<u>Section No</u>	<u>Title</u>
13441	Control Loop Descriptions

2. The System Integrator shall provide all labor, materials, equipment, operations, methods 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 functioning systems.
4. All systems shall be adjusted, tested, inspected and turned over to the Owner in perfect working order.
5. The words "provide", "supply", "supply and install", "install", "furnish" or "furnish and install" shall mean a complete and properly functioning installation performed by the System Integrator. 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 Architectural, Civil, Structural, Process, 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 and network equipment.

B. Work Included:

1. General:

- a. Provide a new Pump Control Panel (PCP) with a PanelView Plus 6-600 OIT and an Allen-Bradley CompactLogix L35E PLC system.
- b. Salvage the MARC Dial-Out 366-100 Modem out of the existing control panel for installation in the new PCP. Provide configuration to establish communications RS-232 DF-1 communications between the PCP PLC and Telemetry PLC at WPCF via dial-out modem communication.
- f. Provide PLC programming and OIT configuration to support the control loop descriptions of Section 13441.
- g. Update the WPCF SCADA system programming and configuration to capture the modified/new monitoring and control functions specified herein and in Section 13441. Provide updates SCADA Screens, communications as required, alarming, trending and reporting.

2. Control Panels:
 - a. Furnish and install new control panels as listed under Subsection 2.2.
 - b. 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.
 - c. Coordinate with the manufacturers of supplied equipment for specific instrumentation and control requirements. Any deviation in instrumentation or electrical required for supplied equipment will be provided at no additional cost to the Owner.
 - d. Install intrinsic safety devices in accordance with UL-698.
 - e. Provide fusing for all analog I/O loops for PLC.
 - f. Provide fusing for discrete I/O, one per logical group of eight.
3. New Instrumentation:
 - a. Furnish and install the instrumentation as shown on the Instrumentation 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.
4. Equipment Control:
 - a. Provide equipment control or connection to control, status indication and alarm annunciation of equipment as shown in the Instrumentation Drawings as described in Section 13441.
5. Miscellaneous:
 - a. Furnish and install all transducers, converters, terminals, transformers, interposing or pilot relays (for both new and existing equipment), signal transmitters, signal splitters/boosters, power supplies, power supply connections and other miscellaneous instrumentation required to make a complete system.
 - b. Furnish and install all vendor or manufacturer wires 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 for each instrument and shall supervise the installation. Furnish and install tubing from each process connection to the primary instrument. Process taps and an isolation valve will be provided under Mechanical in Division 11 and 15. Coordinate the size and type of connection required.
6. Acceptance Testing:
 - a. A non-witnessed Factory Acceptance Test will be performed on each control panel prior to being delivered to the site. The Factory Acceptance Test requirements are described in article 1.2 below.

- b. A Site Acceptance Test will be performed on each control panel after the installation at each site. The Site Acceptance Test requirements are described in article 1.2 below.
- 7. O&M Documentation:
 - a. Provide complete O&M documentation as listed under article 1.4 including panel diagrams, point to point ISA S5.4 diagrams, O&M Manuals, PLC programs, SCADA screen captures, and operator terminal screen captures bound into Volumes.
 - 8. Demolition:
 - a. Remove and/or relocate existing equipment as indicated on the Drawings.
 - b. Deliver items not reused to Owner.
 - 9. 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.
 - b. The System Integrator shall provide protocols for communication between all control panels provided under this project and all existing PLC-based control panels.
 - c. Conduit and wiring (not including integral or vendor furnished cables) will be provided under Division 16 and shown on the Electrical Drawings. Provide ISA S5.4 or equivalent loop diagrams to be used by the electrical subcontractor to properly terminate the wiring at each control panel, transmitter or other instrumentation device provided under this section.
 - d. 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.
 - e. Service calls and additional programming:
 - 1) The System Integrator shall provide one day of service call as described in article 1.2 B 2 of this Section.
 - 2) The System Integrator's programmer shall provide one day of additional programming, at the request of the Owner, during the first year of station operation.
- C. Related Work Specified Elsewhere:
 - 1. Coordination is specified in Division 1.
 - 2. Manufacturer's control systems for process equipment are specified in each section of Division 11.
 - 3. Panels/enclosures required by Section 13440 and the instrumentation drawings shall be furnished in accordance with Section 16160.
 - 4. Panel control components, including switches, lights, relays, etc. not specifically detailed in Section 13440 are to be provided in accordance with Section 16000.

5. Power distribution devices and other electrical work are specified in Division 16.
- D. Related Work by Others under this Contract:
1. Local control stations (including E-stops, local hand switches 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 and accepted 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.
 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.
- 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 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 CONTROL SYSTEM TESTING:

A. Tests Procedures Prior to Start-up:

1. Factory Acceptance Test (FAT): A non-witnessed Factory Acceptance Test and verification for all deliverable equipment, software, and associated documentation shall be performed by the System Integrator 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 are in compliance with the contractual requirements for the deliverables.

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. 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.
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.
4. Instrument Calibration:
 - a. Provide a copy of the factory calibration sheet for each instrument which required factory calibration.
 - b. Verify that each instrument is properly installed and that the control system is properly scaled for the output signal. Provide digital averaging where required in order to provide a smooth but responsive signal.
 - c. Each instrument will be provided with an adhesive sticker declaring the date of certified calibration and initialed by the factory authorized field personnel.

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:
 - 1) Verify the facility installation.
 - 2) Demonstrate each functional requirement identified by the specification using real rather than simulated conditions.
 - 3) Demonstrate all equipment control functions, including the operation of automatic control strategies. Actuation of field

- devices shall be closely coordinated with Engineer and Owner's staff.
- 4) Verify system performance parameters and system responses under field operational conditions.
 - 5) Verify accuracy of documentation, especially operator's manuals, software documentation, panel drawings and site operating instructions.
- b. The System Integrator's test support personnel shall be qualified to resolve and correct problems encountered with the system during the tests. In addition to test support personnel, the System Integrator shall provide all test instruments and equipment necessary to troubleshoot any of the problems encountered.
 - c. The SAT will be observed by the Engineer and/or Owner's representative.
 - d. 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. 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 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. 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.
- D. 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. 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. All necessary provisions will be made to ensure a proper interface between the main process instrumentation and control packages specified within this section and those provided under Division 11.
- E. Acceptable System Integrators:
1. Electrical Installation Inc., Moultonboro, NH
 2. Aaron Associates, Waterbury, CT
 3. R.E. Erickson, Walpole, MA
 4. NIC Systems Corp, Plantsville, CT
 5. Harbor Controls, North Kingstown, RI
 6. Or equal, having a minimum of 5 years' experience in supplying comparable systems.
- F. The System Integrator may be provided with certain items by others for inclusion within their Control Panels. These items are shown as manufacturer's equipment on the Instrumentation Drawings.

1.4 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 be thoroughly checked by the Contractor for compliance with the Contract Documents. Verify that all equipment and materials he proposed to be provided will fit into available space and maintain specified clearances, and that all equipment is compatible with system operation. The submittal of any Shop Drawing implies that the Contractor has reviewed this Shop Drawing and that the above requirements have been met.
 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. 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. Table showing a complete listing of the components in each control panel.
 - 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 numbers and color provide by the Electrical Subcontractor.

4. All material shall be contained in one submission; partial submissions will not be accepted.
 5. Submissions shall be in the form of individual binders, of the quantity indicated in the General Conditions. Each equipment type shall be separated by index tabs with typewritten titles.
 6. Provide samples of instruments, devices, graphics, etc., within 10 days upon receipt of request from the Engineer.
 7. Provide documentation of the ladder logic program and operator interface terminal graphic screens for each control panel for review and comment by the Engineer and Owner. The programs can be submitted as either a Adobe Acrobat compatible pdf file on CDROM or hardcopy including cross ref sheets, I/O configurations and register/address schedule. The PLC program and operator interface terminal screens will be combined as a separate submittal at least 15 days prior to control panel shipment.
- 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.

1.5 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.
- 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.

1.6 O&M REQUIREMENTS:

- A. Upon completion of the work and before request for final payment, deliver to the Engineer six 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 typewritten on 8-1/2" by 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 he is satisfied with the operating instructions given.

- B. 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.
- C. At the completion of the installation, provide six copies of reproducible Record Drawings on sheets no less than 11" by 17" (8.5" by 11" for ISA S5.4 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. The following diagrams shall be included:
 - 1. Panel diagrams on 11" by 17" 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. All diagrams will meet ISA S5.4 standards requirements for loop diagrams on 8½" by 11" or 11" by 17" papers, showing one loop per page.
 - 3. All drawing will be provided to the Owner as record drawings in either Autocad DWG format or Adobe PDF format.
- D. O&M Manual Organization: The 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):

Table of Contents

Section 1 - Reserved for description of system by Owner

Section 2 - Field Instruments (arranged alphabetically by Tag No.)

2.1 ISA data sheet or instrumentation listing

2.2 O&M literature for each type of instrument with labeled dividers

Section 3 - Panel Equipment (arranged alphabetically by manufacturer)

3.1 Device Listing

3.2 O&M and Manufacturer's literature

Section 4 - Miscellaneous devices (arranged alphabetically by manufacturer)

4.1 Device Listing

4.2 O&M and Manufacturer's literature

Section 5 - Drawings

5.1 Panel fabrication and assembly drawings

5.2 Panel wiring diagrams

5.3 ISA S5.4 loop diagrams

Section 6 - PLC

- 6.1 Rack Layout
- 6.2 I/O List
- 6.3 PLC communication parameters
- Section 7 - Program
 - 7.1 PLC Program (with register and cross ref list)
 - 7.2 Operator Terminal Screen Color Printouts
 - 7.3 SCADA Screen Color Printouts
 - 7.4 Report Printouts
 - 7.5 Alarm Configuration
- Section 8 - Software programs and PDF Literature
- Section 9 -Miscellaneous Data

E. The cover and edge of each volume shall contain the following information:

Project Name
Owner's Name

Instrumentation and Control System
Operations and Maintenance Manual
Specification Sections 13440 and 13441
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. In addition to the hard copy O&M data, provide whenever possible an electronic version of all equipment manuals. Electronic version shall be in Adobe™ reader (pdf) format. Graphic files should be in GIF or JPEG format.
 2. Provide electronic files for all custom-developed manuals in Adobe™ reader (pdf) format.
 3. Provide fully documented electronic copy of each PLC program.
 4. Supply all electronic files on 4.8 GB DVD-R media.
- G. Retrofit 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. Specifications and Drawings call attention to certain features, but do not purport to cover all details entering into the design of the instrumentation 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. Power shall be supplied from local electrical distribution panels with breakers for each circuit.
4. All controls for electrically operated or motor-driven equipment (including electrically actuated valves, small pumps and chemical feed equipment, etc.) shall be completed, 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. All motor-operated or electrically operated equipment shall have separate 120-volt control circuits.
6. Control wiring for externally operated motors shall be No. 12 AWG, minimum and in accordance with Section 16160.
7. All necessary fuses or switches required by the instrumentation manufacturer for his equipment requiring a 120V power supply shall have a labeled ON-OFF breaker switch. Refer to Electrical Drawing for instruments requiring power from the control panel.
8. Control panels shall be furnished and installed in accordance with Section 16160, and as indicated on the Drawings and in the Specifications. All transducers, converters, terminals, transformers, relays, signal transmitters, intrinsic safety barriers, intrinsic safety relays, power supply connections and other miscellaneous equipment required to make a complete system in accordance with the intent of this Section shall be furnished and installed in the control panels.
9. 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. 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.
10. Provide all required piping, connections, hangers, supports, etc. required for the Instrumentation and Process Control Systems and equipment.
11. The Drawings and Specifications indicate the energy sources that will be provided. Any other devices necessary to obtain proper operation of the instrument system from these energy sources shall be furnished with the instrumentation.
12. Each alarm-actuating circuit shall contain a simple means for disconnecting the alarm function during normal maintenance or standby of the equipment, which actuates the alarm.

13. All equipment mounted outdoors that requires heating during winter conditions shall be provided with heaters, thermostats, enclosures and associated accessories as necessary in accordance with Section 16160.
14. All recorders shall be by a common manufacturer and shall be of the same manufacturer and type as specified herein.
15. Instrumentation equipment supplier shall provide and install all "vendor furnished cable" between instrumentation system equipment components, unless otherwise indicated. Conduit shall be provided under Division 16 and is shown on the Electrical Drawings.
16. Provide sample conditioning equipment for all analyzers as required by the manufacturer for the intended service. This includes but is not limited to filters, basket strainers, pressure reducing valve, flow control valves, rotameter and pressure gauges.
17. Relays integral to instrumentation equipment shall be Form C with a minimum rating of 5A at 120 VAC.
18. Identification:
 - a. All panels, and panel mounted instruments and control devices shall have identifying nameplates in accordance with Section 16160. Equal quality nameplates shall be attached to all field-installed units.
 - b. Each field transmitter shall have an attached manufactures tag with the Manufactures name, model number, serial number, power requirements, and scaled range of the instrument.
19. Provide suitable lamacoid labels for each process measurement element and transmitter. Label will identifying each media being measured, range and units of measurement and indicating transmitter/element ID No., for example:

Pump Station Discharge Flow Rate
0.0 to 500.0 (gpm)
FIT-120

B. Lightning/Surge Suppression

1. General - Lightning/Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the internal plant electrical distribution system. Protection shall be maintenance free and self-restoring. The surge protector shall be adequate for the intended function and shall be by a nationally recognized manufacturer with a minimum of 3-years' experience in the manufacture of such devices. The technology shall be silicone avalanche diode technology. Submit selected model and backup information for review and acceptance by the Engineer.
2. Field Instrumentation Protection - Provide individual device protection for each field instrument mounted outside of the building or facility housing the control panel. Instruments mounted within the same structure as the associated control panel do not require surge protection.
3. Control Panel Power Supply – Provide protection of all 120 VAC instrument power supply lines. Source voltage to control panels, regardless of location (indoor or outdoor), shall be protected by isolation transformers and surge

suppressors. Provide surge suppressors located at the point where the 120 VAC source supply enters the enclosure. Install the surge device in strict compliance with the manufacturer's recommendation for maximum allowable circuit length between protective device and incoming circuit.

4. Instrument 120 VAC Power Supply – Provide protection for 120 VAC power to all 4-wire field instruments (indoor or outdoor). Provide individual surge suppressors located at the instrument end of the circuit.
 5. 4-20 mA Signal Lines and Non-Fiber Based Data Circuits – 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.
 6. Telephone Circuits - At a minimum, provide telephone company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.
- C. 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. Discrete Output: Sinking 24 VDC Pulse
 - vii. Operating Temperature: -4 to 120 °F
 - viii. Electrical Connections: ½" NPT
 - ix. Enclosure Rating: NEMA 4X
 - x. Communications Protocol: None
 - xi. Memory: Non-volatile
 - xii. Measuring Range: Per Instrumentation Schedule
 - c. Flow Tube Measuring Element:
 - i. Type: Flange Style flow tube for continuous flow measurement
 - ii. Applications:
 - (1) Pretreated Waste Water
 - (2) Liquid Primary and Secondary Sludge
 - (3) Waste Water Final Effluent
 - (4) Drinking Water
 - (5) Dilute Polymer
 - 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: -30 to 150 °F
 - vi. Operating Pressure: Max 230 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. Equivalent to:
 - i. Sitrans FM MAG 3100P with 6000I Ex
 - ii. Rosemount 8712 with 8705 or 8732 and E5 Option
 - iii. Yokogawa ADMAG AXF
 - iv. Or Equal
2. **Float Type Level Switches: LSHH, LSL**
- a. Polypropylene encapsulated non-mercury float switch with oil resistant, waterproof cable
 - b. Normally open contacts rated a minimum of 10A at 120/240 VAC.
 - c. Float switches in Class I Division 1 (explosion proof) areas shall be protected with an intrinsically safe relay.
 - d. An adjustable weight shall be attached to each float cable
 - e. Provide a stainless-steel float rack for each series of switches with adjustable cable stops.
 - f. For installation in the wet well, the manufacturer provided float switch cable shall terminate at an explosion proof junction box rated for Class I Division 1 installations. The explosion proof junction box shall be provided by Division 16 and located at the respective wet well. The cable shall be spliced in the junction box and extended to the respective control panel.
 - g. Equivalent to:
 - 1) Series M by Warrick Controls
 - 2) LS Float Switch by Siemens
 - 3) Signal Master by SJE Rhombus
 - 4) or equal
3. **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 4X, IP68
 - vi. Communications Protocol: None
 - vii. Measuring Range: Per Instrumentation Schedule
- c. Measuring Element:
 - i. Type: Submersible Elastomeric Diaphragm Pressure Sensor
 - ii. Applications:
 - (1) Pretreated Waste Water
 - (2) Liquid Primary and Secondary Sludge
 - (3) Waste Water 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. Process fluid shall directly act on the outer diaphragm. The pressure from the process fluid shall be transmitted to the pressure measuring element by the silicone oil fill fluid.
- f. 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.
- g. 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.
- h. The cable will be extended to an explosion proof junction box, provided by Division 16. 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

4. **Temperature Element, Indicator with Switch: TSL, TSH**

- a. Provide temperature switch, as indicated in the Instrumentation Schedule, with the following requirements.
- b. Temperature Switch:
 - i. Type: Single point temperature switch with thermistor type sensor. Sensor and relay shall be provided by the same manufacturer and shall be matched to make a function instrument system.
 - ii. Applications:
 - (1) Air
 - iii. Display: LCD
 - iv. Power: 120 VAC
 - v. Analog Output: None
 - vi. Enclosure Materials: Thermoplastic
 - vii. Switch Contacts:
 - (1) SPDT
 - (2) 10 amps at 120 VAC
 - viii. Setpoint Adjustment: Programmable through onboard keypad
 - ix. Operating Temperature: 32 to 122 °F
 - x. Enclosure Rating: NEMA 4X
 - xi. Electrical Connections: $\frac{1}{2}$ " NPT
 - xii. Memory: Non-volatile
 - xiii. Mounting: Wall Mountable
- c. Accessories and Spare Parts:
 - i. None
- d. Equivalent to:
 - i. Ranco

- ii. Honeywell
 - iii. Johnson Controls
 - iv. Or equal
5. **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 508A.
 - c. Approvals: FM
 - d. Equal to:
 - 1) Phoenix Contact
 - 2) Gems Safe-Pak
 - 3) MTL 7700 Series
 - 4) or equal
6. **Intrinsically Safe Barrier**
- e. Barriers shall be provided for all intrinsically safe sensing or actuation circuits which terminate in hazardous areas.
 - f. Barrier shall be located in non-hazardous areas and installed in accordance with UL 508A.
 - g. Approvals: FM
 - h. Equal to:
 - 1) Phoenix Contact
 - 2) Gems Safe-Pak
 - 3) MTL
 - 4) or equal
7. **24 VDC Power Supplies**
- a. Provide 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 24 VDC power shall be powered from a single 24 VDC power supply.
 - c. Input voltage: 115 VAC
 - d. Output voltage: 24 VDC.
 - e. Ripple: <50 mVpp.
 - f. The power supply shall be sized to accommodate 125% of the design load.
 - g. Operating temperature: 32 to 140 °F
 - h. The power supply shall be provided with a means to protect instruments from over current and over voltage.
 - i. Mounting: Din rail mount inside control panel. Power supply shall be located in the control panel such that heat generated does not cause other panel components to malfunction or become damaged.
 - j. Equal to:
 - 1) Phoenix Contact
 - 2) Sola

- 3) Allen-Bradley
 - 4) or Equal
8. **Control Panels**
- a. Control panels shall meet the requirements of Section 16160.
 - b. Provide control panels as listed in 2.2 of this section.
9. **Miscellaneous Hand Switches and Indicator Lights: HS, YL, AL**
- a. Size: 30 mm
 - b. All indicator lights shall be 120 VAC, LED with push to test option.
 - c. Reference Section 16000 for specifications.
 - d. Number of positions and nameplate legends shall be as indicated in Section 13441 and on the Drawings.
10. **Operator Interface Terminal: OIT**
- a. General: Provide an operator interface terminal 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 following Control Panels provided by Division 13 shall have an OIT: Pump Control Panel (PCP).
 - b. Screen Size: 5.7-inch diagonal color active matrix screen with a minimum resolution of 320 by 240 pixels with field replaceable backlight.
 - c. Interface: Touch screen rated at 1 million cycles (minimum) and keypad
 - d. Memory: 256 MB minimum application and graphic memory. The operator interface terminal shall also include a compact flash port.
 - e. Clock: Provide integral real-time clock with battery backup.
 - f. Communication ports: One (1) RS-232, one (1) Ethernet, and two (2) USB.
 - g. Power: 120 VAC or 24 VDC
 - h. Operating Temperature: 32 to 131 °F
 - i. Enclosure: NEMA 12 with NEMA 4X touch screen
 - j. Provide programming time required to configure operator terminal interface as described in Sections 13440, 13441 and finalized in the instrumentation meetings.
 - k. Provide all cables required to connect the operator terminal to the PLC as shown on the Drawings.
 - l. Provide window kit and sun-shield.
 - m. Acceptable Operator Interface Terminal (OIT):
 - 1) Allen-Bradley PanelView Plus 6-600 color keypad/touch screen, to match the Owner's installed base of OIT equipment.
 - 2) No equivalent
11. **UPS Power Supply Backup System**
- a. Provide an uninterruptible 120-volt backup power supply for components within the Pump Control Panel to maintain continuous operation of the operator interface terminal, monitoring instrumentation and control circuits during a power outage. The UPS shall provide backup power to the following:

- 1) The OIT and PLC
- 2) +24VDC Power Supply
- 3) Dial-Up Modem
- 4) Magnetic Flowmeter FIT-120
- 5) TSL-190
- 6) Control circuits and control circuit devices at the Pump Control Panel
- 7) Do not power PCP lighting or environmental controls from UPS power.
- b. The UPS shall be provided with surge arresting capabilities to prevent sudden surges to the attached electrical control systems.
- c. The UPS will be either rack mounted inside the control panel, located in the bottom section of floor stand type control panels or provided an independent wall mounted enclosure.
- d. Provide appropriate electrical disconnect or provision to easily remove and bypass the UPS.
- e. The UPS shall be type rated for industrial use and capable of supplying standby power to all connected control panel equipment and circuits for a minimum of fifteen (15) minutes at full load. UPS minimum rating shall be 750 VA.
- f. Equivalent to APC Backup Pro, Ferrups, Triplite or equal.
12. **Surge Suppressor**
 - a. Transtector, Ditek Model # DTK -120/240CM or equal
13. **Fuses and Fuse Blocks:** refer to Section 16000
14. **Terminals:** refer to Section 16000
15. **Special Tools**
 - a. The Contractor shall provide all required tools for instrumentation.
16. **Spare Parts and Test Equipment**
 - a. The Contractor shall furnish the following spare parts, in addition to the manufacturer's standard spare parts kit, with each part packed in a container and labeled:
 - 1) 2 of each type lamp, unless otherwise specified herein
 - 2) 1 of each color indicator light lens
 - 3) 1 relay of each type
 - 4) 1 complete selector switch of each type
 - 5) 1 complete push-button of each type
 - 6) 1 of each different contact block for control units
 - 7) 2 of every type of fuse
 - 8) 1 N.O. and 1 N.C. contact for each type of switch

2.2 CONTROL DESCRIPTION (refer to Instrumentation drawings and Section 13441 for functional description of automatic operation)

A. General:

1. Run time totalizers (KQI) for each piece of equipment will be located on the front of Pump Control Panel and the Bubbler Control Panel. The PLC will also totalize the run times for the submersible wet well pumps.
- B. Control Panels (CP):
1. Local Control Stations (LCSs) will be provided under Division 16.
 2. The following Local Control Panels (LCPs) will be provided under this Division:
 - a. Pump Control Panel (PCP), wall mounted, with NEMA 12 enclosure rating. The panel shall be a one-door. The panel shall include monitoring and control devices, and appurtenances, all provided under Division 13.
 3. The Pump Control Panel shall be as follows:
 - a. The Pump Control Panel shall be a wall-mounted one-door enclosure with 120 VAC control power distribution, control devices and panel instruments. Refer to the schematic diagrams on the Instrumentation Drawings for additional requirements.
 - b. The Pump Control Panel shall house the new Operator Interface Terminal specified herein, and pump monitoring and control devices as specified herein and in Section 13441, and as shown on the Drawings.
 - c. The Pump Control Panel shall house the intrinsically safe relays and for the wet well high-high level and low-low level float switches, installed per UL requirements.
 - d. The Pump Control Panel shall house the intrinsically safe barrier and for the wet well level transmitter, installed per UL requirements.
 - e. The pump control panel shall contain an uninterruptible power supply (UPS) as specified herein for providing power to the instruments and devices identified in article 2.1.C.11 of this Section.
 - f. Provide sufficient space on the left and right side of the PLC System to accommodate a future installation of two (2) additional modules per side.
 - g. Provide a 6" x6" space for a future PoE Ethernet Switch. Provide +24vdc power terminals for future use.
 - h. Power the PLC from the UPS.
 - i. The Pump Control Panel shall serve as the collection point for a field wiring for input/output signals from instruments and other panels as shown on the Drawing. The System Integrator shall provide sufficient number of terminal blocks with 20% spare capacity within the Pump Control Panel to accommodate these signals. The field wiring for the following, as shown on the Drawings shall be terminated at the Pump Control Panel for connection to PLC I/O. Provide an additional 20% spare space in the control panel for future expansion.
 4. All Local Control Panels will be located as shown on the Electrical Drawings.
 5. In general, each piece of equipment will have a HAND-OFF-AUTO (HOA) hand switch (HS) mounted on the Pump Control Panel. In the HAND position, the equipment will run continuously and the equipment will be capable of running properly without the PLC with speed control for a local speed pot on the PCP. In the OFF position, the equipment will not be

- allowed to run. In the AUTO position, control of the equipment will be transferred to the PLC and a signal shall be sent to the PLC indicating that the piece of equipment is available for automatic control.
6. The SCADA system will display the status of each piece of equipment. The operator will be capable of adjusting process parameters and setpoints.
 7. All alarms shall activate an alarm light(s) at the associated control panel (where indicated on the Instrumentation Drawing) and at the operator interface terminal and SCADA system as specified in Section 13441. Each alarm will be latching unless otherwise indicated. A software reset function will also be provided through the Operator Interface Terminal (OIT) for programmed alarms only. Alarms that are latched by a relay in the control panel will require the operator to RESET the control panel.
 8. All motor drives, including motor starters, soft starts and variable speed drives, will be activated based on a START command from the PLC or HOA switch. The RUN command will be developed by the control panel circuitry driving an auxiliary control relay in the Control Panel. The PLC will not be capable of activating the equipment if the equipment is in the HAND or OFF positions. The control circuitry will include all permissive conditions, interlocks and run commands (PLC and HOA switches).
 9. A return RUN contact from the drive will activate a RUN light mounted to the front of the motor control center (MCC), variable speed drive (VFD) or control panel for each piece of equipment. The PLC will activate a FAIL alarm at the operator terminal, if the equipment is in AUTO and the PLC attempts to activate the equipment but the RUN contact does not indicate that the equipment is running, or the RUN signal is lost during equipment operation after an operator adjustable delay period.
 10. Drive equipment and instrumentation, which contain self-diagnostics, VFD fault relay (FAULT) contacts, will be connected to the PLC to produce an VFD FAULT alarm at the OIT and SCADA.
 11. The PLC will be programmed to perform the functions as described in Section 13441 or as required by the manufacturer of the equipment. The layout, functions and controls for each process control panel will be coordinated through the Engineer and finalized at instrumentation meeting(s).
 12. All analog control signals will be 4-20 mA DC and powered from power supplies within the process control panel, unless otherwise indicated or required.
 13. All discrete inputs to the PLC shall be dry isolated contacts.
 14. All discrete outputs from the PLC shall have interposing relays. Interposing relays shall be provided for each in use and spare PLC discrete output.
 15. All outgoing power (120 volt and 24 volt) to field devices shall be fused.
 16. All wiring in and out of the panels will be connected to single tier terminal strips for ease of installation and maintenance. All connections will be made in such a way as to preserve the NEMA rating of the panel. The supplier will label the terminal strips and provide a complete wiring diagram for each system control panel.

17. All control panels will use the following light color convention:
 - a. Run Red
 - b. Stop Green
 - c. Warning Amber
 - d. Alarm Red
 - e. Power White
 - f. Position Blue
18. The Control Panels shall be furnished and installed in the locations as shown on the Electrical Drawings.
19. All transducers, converters, terminals, transformers, relays, signal transmitters, signal boosters, power supply connections, remote instrumentation/equipment surge protection devices, and other miscellaneous equipment required to make a complete system in accordance with the intent of this section of the Specifications shall be furnished and installed in each panel.
20. The System Integrator shall review the control section of the submittal for each Division 11 or Division 16 specification where equipment drive controls or equipment protective devices are to be provided and interfaced with the new Instrumentation and Process Control System.

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, doveled, 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.

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. 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.
4. Process calibration, such as volumetric drawdown tests on flows and level measurements, shall be conducted on all measuring systems as requested by the Engineer.

INSTRUMENTATION SCHEDULE

TAG	TYPE/ SIZE	DESCRIPTION	LOCATION	RANGE	UNITS	SERVICE	POWER	SPEC. SECTION
LT-100	Sub	Submersible Wet Well Level Transmitter	Wet Side (wet well)	0 - 6.0	feet	Class I, Div. 1	24 VDC Loop	13441 2.1.C.3
LSHH-100	Float	Wet Well High-High Level Float Switch	Wet Side (wet well)	N/A	N/A	Class I, Div. 1	N/A	13441 2.1.C.2
LSSL-100	Float	Wet Well Low-Low Level Float Switch	Wet Side (wet well)	N/A	N/A	Class I, Div. 1	N/A	13441 2.1.C.2
FE/FIT-120	MAG / 4-in	Pump Station Discharge Flow Meter	Flow Tube: Wet Side (process pipe) Flow Transmitter: Generator Room	0 - 250	gpm	Flow Tube: Class I, Div. 1 Flow Transmitter: NEMA 4X	120 VAC for Transmitter	13441 2.1.C.1
TSL-190	Temp	Building Low Temperature Switch	Electrical Room	0-110	°F	NEMA 4X	120 VAC	13441 2.1.C.4

END OF SECTION

SECTION 13441

CONTROL LOOP DESCRIPTIONS

PART 1- GENERAL

1.1 SUMMARY

- A. Section includes control descriptions for loop diagrams shown on the Instrumentation Drawings.

1.2 SYSTEM DESCRIPTION

- A. Provide instrumentation hardware, software and programming as necessary to perform control functions specified herein and as shown on the 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.

1.3 SUBMITTALS

- A. Operation and Maintenance Manuals:
 - 1. Provide annotated final versions of the PLC programming files on DVD.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 CONTROL LOOP DESCRIPTIONS - GENERAL

- A. General Configuration Instructions
 - 1. Operator interface terminal (OIT) and SCADA software will be used for process monitoring and control as noted in the specific control loop descriptions. OIT and SCADA HMI screens shall be constructed in accordance with the following general guidelines:
 - a. Overview Screen showing status and approximate location of each process related field instrument and process equipment. Operators shall be able to access more detailed overview screens for equipment control, alarm history, and alarm setpoints.
 - b. Process Equipment Control Screens: Screens and pop-up displays shall be provided for process equipment monitoring, equipment control, and operating parameters/setpoints adjustment as described in this Section and Section 13440.

- c. Alarm Summary and Alarm Set-up Screens: Screens shall be provided to display active alarms, entry of alarm setpoint values and timer settings, and on/off alarm selection as described in this Section and Section 13440.
 - d. 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.
 - e. Alarm History Screen: A screen shall be provided to display all active alarms. The operator shall acknowledge and reset alarms from this screen.
 - f. Provide an alarm banner on each SCADA HMI screen that displays at a minimum the three most recent alarm conditions. Active alarms shall be flashing in red.
 - g. Process Variable Historical Trends: Screens shall be provided to display historical trends of process variables as noted in the descriptions below.
2. All process, operational and alarm setpoints will be adjustable through the OIT/SCADA HMI screens and will be generated and controlled at each respective PLC.
 3. All alarms generated from process switches or equipment contacts will have a means through the OIT/SCADA HMI to activate/deactivate the alarm and adjust an on-delay timer setting (0 - 60 seconds, initially 5 seconds) unless otherwise indicated.
 4. All alarms generated from analog process values will have a means through the OIT/SCADA HMI to activate/deactivate the alarm, adjust the setpoint, and adjust an on-delay timer setting (0 - 60 seconds, initially 5 seconds) unless otherwise indicated.
 5. Analog inputs shall be presented in both real-time and historical trend formats. Real-time trends shall be configured to display the last 5 minutes to 2 hours of data, as determined by the Owner and the Engineer. Historical trends shall be configured to display the last 4 to 24 hours of data as determined by the Owner and the Engineer. Real-time trends shall be shown on the associated process graphic display for the analog point if practicable.
 6. For all driven equipment, the PLC shall compute the elapsed runtime from the run state signal of the equipment. The elapsed runtime shall be displayed at the OIT and SCADA HMI.
 7. For all driven equipment, the PLC shall annunciate a run failure alarm if the equipment has been commanded to start by a PLC output and the run contact state does not indicate that the equipment is running after the expiration of an adjustable on-delay timer, initially set at 5 seconds.

3.2 CONTROL LOOP DESCRIPTIONS

- A. Loop 100 - Wet Well Level Monitoring and Control
 1. General: Wet well level is measured by a submersible level transducer, and wet well level is used for automatic control of the submersible wet well pumps.

High-high and low-low level float switches in the wet well are used for backup level control.

2. Local Monitoring/Control:
 - a. Wet Well Level Monitoring:
 - 1) A level transmitter, (LT-100) located in the wet well provides wet well level measurement.
 - 2) A low-low and high-high level switch provide backup level control in the event of PLC or level transmitter failure.
 - b. Pump Control Panel:
 - 1) A Backup Level Control On/Off selector switch (HS-100B) is located at the Pump Control Panel. When the switch is in the ON position, backup level control is enabled for any pump that is in AUTO mode (see Loops 110 and 111).
 - 2) A Backup Level Control On indicating light (YL-100) is located at the Pump Control Panel and is illuminated when the selector switch is in the ON position. A discrete input for the existing RTU PLC is provided for indication at the OIT and SCADA HMI that backup level control is enabled.
 - 3) A hard-wired control circuit in the Pump Control Panel will operate the submersible pumps if backup level control is enabled, the low-low level float switch (LSLL-100) and high-high level float switch (LSHH-100) are activated, and the pump is in AUTO mode. Intrinsically safe relays LY-100A and LY-100B are located in the Pump Control Panel. A schematic of the control circuit is found in the Instrumentation Drawings. Only one pump shall operate at a given time. Pump #1 is designated to start. If Pump #1 is not running and there is a VFD Fault, Pump #2 will start.
 - 4) If the PLC Faults, a discrete output shall de-energize and a normally closed relay contact shall energize CR3 and CR4 to provide backup speed preselection of 60Hz to VFDs (programmed in VFD).
3. PLC Functions:
 - a. Inputs:
 - 1) AI: Wet Well level (LT-100, 4 - 20 mA DC scaled to 0.0 - 6.0 feet)
 - 2) DI: High-High Level (detected by field instrument LSHH-100). LSHH shall be installed so that the NO contact closes when wet well level reaches elev. 436.50.
 - 3) DI: Low-Low Level (detected by field instrument LSLL-100). LSHH shall be installed so that the NO contact closes when wet well level reaches elev. 433.50
 - 4) DI: Backup Level Control enabled
 - b. The proposed measuring range and level backup control setpoints are as follows:

CONTROL LOOP DESCRIPTIONS

	Level (ft.)	Elevation
High-High Level Alarm	4.50	436.50
Low-Low Level Alarm	1.50	433.50

- c. The proposed measuring range and level alarm setpoints are as follows:

	Level (ft.)	Elevation
Highest Measured Level	6.16	436.66
High-High Level Alarm	6.00	436.50
High Level Alarm	5.75	436.25
Low Level Alarm	3.25	433.75
Low-Low Level Alarm	1.50	433.50
0 Depth	0.00	430.50

- c. Automatic Level Control:

- 1) Pump start and stop control is based on wet well level. In AUTO mode, the Lead pumps\ will run when level exceeds the associated start setpoint. The pump shall continue to run until level drops below the associated stop setpoint. See Loops 110 and 111.
- 2) The proposed pump control setpoints are as follows:

	Level (ft.)	Elevation
Lead Pump On	5.50	436.00
Lead Pump Off	3.50	434.00

4. Alarms at OIT and SCADA HMI:
 - a. High-High Level
 - b. High-Level
 - c. Low Level
 - d. Low-Low Level
 - e. Level alarm setpoints and timer settings
5. Monitoring/Status/Control at OIT and SCADA HMI:
 - a. Level indication and trend (no trend at OIT)
 - b. Pump start/stop control setpoints
 - c. Backup Level Control Enabled Status

B. Loops 110 and 111 - Submersible Wet Well Pumps

1. General: The pumps discharge the contents of the wet well to a force main. The pumps can be operated in manual mode, or in automatic mode based on wet well level.
2. Local Monitoring/Control:
 - a. The Division 13 furnished local Pump Control Panel (PCP) contains the following:

- 1) Hand/Off/Auto Selector Switch (HS-##B): When the H/O/A selector switch is in the HAND position, the equipment will run. 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 the PLC logic is enabled.
 - 2) Run Indicating Lights (YL-##B)
 - 3) Speed Pot (HSC-##)
 - b. VFD Control Circuit Interlocks: The VFD control circuit contains a hard-wired interlock to shut down the equipment on a motor high temperature condition. The interlock is latching and is un-latched using the reset pushbutton at the VFD.
3. 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: Seal fail
 - 6) DI: ESTOP
 - 7) DO: Start command
 - 8) AI: Speed Feedback
 - 9) AI: Amps
 - 10) AO: Speed Command
 - b. Automatic Operation:
 - 1) Automatic Operation Logic: Equipment operation is controlled by start/stop commands generated by the logic of Loop 100.
 - 2) A service selection table will be provided at OIT/SCADA HMI screens so that each piece of equipment can be selected as Lead or Standby 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 HMI, then the equipment is alternated in the service designations as follows:
 - a) 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.
 - b) If TIME basis is selected, the pumps shall be alternated in the service positions 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 a VFD Fault, Motor High Temperature, 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 or SCADA HMI.

- 2) The PLC DO start command shall be disabled when there is a loss of control power to the PLC. When control power becomes available, two software on-delay timers are started (initially set for 30 and 60 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 Standby Pump is re-enabled.
4. PCP Hard-wired Backup Control: Contacts from the wet well high-high level float switch (LSHH-100) and the low-low level float switch (LSSL-100) are used in a hard-wired backup level control circuit. 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 and SCADA HMI shall display the message: PUMP NO. * NOT AVAILABLE FOR BACKUP LEVEL CONTROL.
 5. Alarms at OIT and SCADA HMI:
 - a. VFD Fault
 - b. Motor High Temperature
 - c. Seal Fail
 - d. Run Failure
 - e. High Motor Amps Warning/Alarm with Setpoints
 6. Monitoring/Status/Control at OIT and SCADA HMI:
 - a. H/O/A Selector Switch in AUTO
 - b. Run Status
 - c. Elapsed Runtime Meter (0.0 - 999,999.9 hours)
 - d. Service Selection Table and Auto Alt. Pushbutton
 - e. Lead/Standby Status
- C. Loop 120 - Pump Station Discharge Flow Rate Monitoring
1. General: The pump station discharge flow rate is measured and a flow total is computed.
 2. Local Monitoring/Control:
 - a. Local indication of flow rate at FIT-120.
 - b. Local Indication of flow totalization FQIT-120
 3. PLC Functions:
 - a. Input: AI, flow rate (4 - 20 mA DC scaled to 0.0 - 250.0 gpm)
 - b. Input: DI, flow totalization pulses.
 - 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:

$$\text{Flow total (MG)} = \{(\text{flow rate}) \div (60 \times 10^6)\} \times (\text{PLC scan time}),$$
 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 and SCADA HMI:
 - a. Loss of Flow Signal.
 5. Monitoring/Status/Control at OIT and SCADA HMI:
 - a. Flow Rate indication and trend (no trend at OIT)
 - b. Flow Total indications ($0.00 - 999,999.99 \times 10^6$ gallons)
- D. Loop 160 – ATC-1 Common Alarm (future)
1. General: A common Alarm Contact is issued by the ATC-1 when an alarm condition occurs.
 2. Local Monitoring/Control:
 - a. At Automatic Temperature Control Cabinet
 3. PLC Functions:
 - a. Input: DI XA-160
 4. Alarms at OIT and SCADA HMI:
 - a. ATC Alarm
 5. Monitoring/Status/Control at OIT and SCADA HMI:
 - a. Reset pushbutton
- D. Loop 170 – Fire Alarm
1. General: A common Fire Alarm Contact is issued by the Fire Alarm Terminal Cabinet when the following conditions occur: Generator Room Smoke Detection, Electrical Room Smoke Detection, and Wetwell Room Heat Detection.
 2. Local Monitoring/Control:
 - a. At Fire Alarm Terminal Cabinet
 3. PLC Functions:
 - a. Input: DI TSL-190
 4. Alarms at OIT and SCADA HMI:
 - a. Low Building Temperature Alarm
 5. Monitoring/Status/Control at OIT and SCADA HMI:
 - a. Reset pushbutton
- E. Loop 180 - Generator and ATS Monitoring
1. General: Status and alarms of the station generator and ATS are monitored.
 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: Not in AUTO
 - 4) DI: Low Fuel
 - 5) DI: Normal

- 6) DI: Emergency
 - 7) DI: ESTOP (Gen)
 4. Alarms at OIT and SCADA HMI:
 - a. Generator Failure
 - b. Low Fuel
 - c. Emergency (ATS)
 - d. Gen. Emergency Stop
 5. Monitoring/Status/Control at OIT and SCADA HMI:
 - a. Run Status indication
 - b. Elapsed Runtime Meter (0.0 - 999,999.9 hours)
 - c. Generator Not in Auto indication
 - d. Normal (ATS)
- F. Loop 190 - Building Low Temperature
1. General: Alarm when building temperature drops below the temperature switch setpoint (40°F default).
 2. Local Monitoring/Control:
 - a. None
 3. PLC Functions:
 - a. Input: DI TSL-190
 4. Alarms at OIT and SCADA HMI:
 - a. Low Building Temperature Alarm
 5. Monitoring/Status/Control at OIT and SCADA HMI:
 - a. Reset pushbutton
- F. Loop 200 – Generator Dampers
1. General: Open Status of Generator Dampers #1 & #2.
 2. Local Monitoring/Control:
 - a. None
 3. PLC Functions:
 - a. Input: DI ZSO-200A Generator Damper #1 Open
 - b. Input: DI ZSO-200B Generator Damper #2 Open
 4. Alarms at OIT and SCADA HMI:
 - a. General Alarm: If Generator Running, and a Damper is not Open after a 30 second time delay, issue a fail to open alarm for that damper.
 - b. Damper #1 Fail to Open Alarm
 - c. Damper #2 Fail to Open Alarm
 5. Monitoring/Status/Control at OIT and SCADA HMI:
 - a. Reset pushbutton

END OF SECTION

SECTION 14320HOIST SYSTEMSPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Furnish, install, and test manual and electric hoist systems as shown on the Drawings and as specified herein.
- B. The hoist systems shall be complete with I or S-beam track, monorail track, swing out section, trolley, hoist and all appurtenances necessary to complete the installation.

1.2 RELATED SECTIONS

- A. Section 01340 - Submittals
- B. Section 01800 - Equipment Startup, Certification and Operator Training
- C. Section 05500 - Metal Fabrications
- D. Section 09900 - Painting
- E. Section 09905 - Surface Preparation and Shop Coatings
- F. Section 11000 - Equipment General

1.3 REFERENCES

- A. AISC - American Institute of Steel Construction
- B. AWS - American Welding Society
- C. ASME B30.11 2010 - Monorails and Underhung Cranes
- D. ASME B30.16 - 2007 -Overhead Hoists (Underhung)
- E. HMI - Hoist Manufacturers Institute
- F. MMA - Monorail Manufacturers Association
- G. OSHA - Occupational Safety and Health Administration

1.4 SUBMITTALS

- A. Submit complete shop drawings as specified in specification sections 01340 and 11000 and including but not limited to;
 - 1. Equipment specifications and data sheets identifying all materials used and methods of fabrication. Weights of all component parts and assembled weight of units.
 - 2. Complete assembly, layout and installation drawings with clearly marked dimensions.
 - 3. Spare parts recommended by the manufacturer.
 - 4. Special tools necessary to disassemble, service, repair and adjust the hoist systems.
 - 5. Installation, start-up, operating and maintenance instructions.
 - 6. Warrantee/guarantee

1.5 QUALITY ASSURANCE

- A. All of the monorail track, swing out section and trolley equipment on the monorail track shall be provided by a single, experienced and qualified manufacturer who is a member of the Monorail Manufacturers Association.

- B. Trolley equipment for hoists on I-beam track shall be provided by the hoist manufacturer.
- C. All of the hoisting equipment shall be provided by a single, experienced and qualified manufacturer who is a member of the Hoist Manufacturers Institute.
- D. All components and installations shall be the responsibility of one manufacturer.
- E. The current issue of Underhung Cranes and Monorail Systems by the MMA and the Hoist Manufactures Institute shall be included as a part of this section unless otherwise specified.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Contractor shall be responsible to off load, store and cover hoisting systems and protect controls and electrical equipment from moisture.

PART 2 - PRODUCTS

2.1 HOIST SCHEDULE

Location	Capacity	Hoist	Trolley	Lift Height	Service Class	Remarks
Pump Room	0.5 ton	M	M	30'-0"	H1	LHR, XP, CR

M - Manual; E - Electric; LHR - Low headroom; SHR - Standard Headroom; XP - Class 1/Division 1 or Division 2; CR - Corrosion resistant materials; H1 - Infrequent Use

2.2 SYSTEM REQUIREMENTS

- A. Manual Hoists with Integral Trolleys
 - 1. Hoist: Low headroom, manual, chain type with a maximum distance of 18 inches from the bottom of the monorail track or I-beam to the center of the lift hook at its highest position.
 - a. Lift Capacity - As indicated in the Schedule
 - b. Lift - As indicated in the Schedule
 - c. Maximum chain pull required to lift load:
 - i. 0.5 ton - 46 pounds
 - ii. 1.0 ton - 69 pounds
 - iii. 1.5 ton - 80 pounds
 - iv. 2.0 ton - 83 pounds
 - 2. Standard I or S-Beam Track as shown on the Drawings.
 - a. I or S-Beam shall be furnished and installed in Specification Section 05500.
 - b. End stops shall be furnished and installed in Specifications Section 05500.

2.3 MANUFACTURERS

- A. Manual Hoists with Integral Trolleys
 - 1. Columbus McKinnon Corporation, Amherst, NY
 - 2. TC/American Monorail, Inc., St. Michael, MN
 - 3. ACCO Material Handling Solutions, York, PA
 - 4. Or equivalent

2.4 TROLLEYS

- A. Trolleys shall be manufactured with heavy section rolled steel side frames.
- B. Wheels shall be induction hardened to a minimum of 425 Brinell. Bearings shall be double row, combination radial and thrust, anti-friction precision type. They shall be prelubricated and sealed and have a minimum B-10 bearing life of 5,000 hours.
- C. Trolleys shall fit on standard "I or S" type structural beam or Monorail Track as indicated on the Structural Drawings.
- D. Trolley wheel gears and pinions shall have machined cut geared teeth. Spacer washers shall be provided for trolley adjustments to various beam sizes.
- E. Movement of hand-gearred trolleys is accomplished by pulling on an endless zinc plated hand chain. All chain shall be certified as non-sparking.
- F. Trolleys shall be provided with rubber bumpers capable of stopping a trolley at an average rate of deceleration not to exceed 4.7 ft/s/s when traveling in either direction at one-third of the rated load speed.

2.5 HOISTS

- A. Hoists shall have safety-type lug mounted connection.
- B. Hoists shall have full blocks with safety latch swivel hook. Hooks shall be bronze or high bronze alloy in Explosion Proof areas.
- C. Each manual hoist shall have enclosed gear train, screw and disc type load brakes, slip clutch type load limiting device and anti-friction bearings throughout.
- D. Provide chain baskets for all chain hoists. All chain shall be certified as non-sparking.

2.6 RATED LOAD

- A. Each hoist shall be marked with its rated load. These markings shall be clearly legible from the loading position.
- B. Both sides of the each monorail track and/or I-beam shall be marked with its rated load. These markings shall be clearly legible from the floor below.

2.7 SURFACE PREPARATION AND SHOP COATING

- A. Provide surface preparation and shop coatings in accordance with Specification Section 09905.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractor shall verify all dimensions and clearances in the field prior to erection and shall be responsible for the proper fitting and operation of the equipment.
- B. Install in strict accordance with the manufacturer's instructions and Specification Section 11000. Installation shall include furnishing any required oil and grease in accordance with the manufacturer's instructions.

3.2 USE DURING CONSTRUCTION

- A. At no time during the construction period shall the monorail, I-beam, hoist and trolley be used by the Contractor for construction purposes. The hoist/trolley manufacturer shall render the equipment inoperable until final testing, checkout and startup.

3.3 START UP AND TESTING

- A. In accordance with Specification Sections 01800 and 11000.
- B. The monorail, trolley and hoist shall be tested at the rated load by the Contractor to demonstrate the ability to lift and continuously transport the load throughout the entire length of the runway.
- C. Contractor shall provide necessary weights, slings, etc., necessary for conducting the test. Weights shall be calibrated.

3.4 CLEANING

- A. Contractor shall thoroughly clean all installed materials and equipment and touch up factory finish as required.

END OF SECTION

SECTION 15050PIPE & PIPE FITTINGS – GENERALPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish, install, support, and test pipe and pipe 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 (When Applicable):
 - 1. Excavation and backfill are specified in Division 2.
 - 2. Concrete cradles, arches, and encasements are specified in Division 3.
 - 3. Painting and Pipe Identification are specified in Section 09900.
 - 4. Surface Preparation and Shop Coatings are specified in Section 09905.
 - 5. Valves, gates, pipe hangers, pipe supports, pipe and equipment insulation, heating, and plumbing are specified in the appropriate Sections in Division 15.
 - 6. Pipe materials are specified in the appropriate sections of Division 2 and/or Division 15.
- C. Other Trades: Cooperate with all other trades whose work is to be coordinated with piping work.

1.2 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. ANSI B31.1 – Power Piping
 - 2. ANSI B31.3 – Process Piping
 - 3. ANSI B31.4 – Liquid Transportation Systems for Hydrocarbons,
 - 4. Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohol.
 - 5. ANSI B31.5 – Refrigeration Piping
 - 6. ANSI B31.9 – Building Services Piping
 - 7. ANSI B31.8 – Gas Transmission and Distribution Piping Systems

1.3 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01340 and the General Conditions of the Construction Contract.
- B. Submit manufacturer's "Certification of Conformance" that pipe and fittings and other piping appurtenances meet or exceed the requirements of these Specifications.
- C. Submit other documents as specified in the appropriate Sections of this Division.
- D. Submit complete pipe support system design stamped by a Professional Engineer registered in the State of Connecticut with at least 5 years of experience in the analysis and design of similar system within the last 5 years.
- E. Computerized calculations with supporting and backup documentation will be acceptable.
- F. The design of the pipe support system shall include analyzing the system piping and service conditions to develop a detailed support system, specific to the piping material, pipe joints, valves and piping appurtenances.
- G. The support system design shall include the criteria for each piping system.

- H. The piping system analysis and design shall conform to ANSI B31.
- I. The support system shall be designed for dead weight and dynamic analysis, including system thermal effects, pressure thrusts and seismic forces. Refer to paragraph 1.4 Seismic Control for seismic requirements.
- J. 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.
- K. Submit complete layouts, schedules, and location plans for all piping systems.
- 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 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 Sewer System: Clean and test in accordance with the "Plumbing General" Section in Division 15.
- C. Outside Sewer Lines (CLASS II): CLASS II pipe testing shall be performed in accordance with Section 02755.
- D. 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 his 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. PRESSURE (PSI)	DELTA OPER. TEMP. (degF)
--	Manual Air Release and Recirculating Line	EXPOSED	ALL	316 SS	WELDED	CLASS IV	No	-	-
FM	FORCE MAIN	BURIED	<4"	Class 52 DI	PUSH-ON	CLASS IV	N/A	-	-
		EXPOSED	<6"	CLASS 53 D.I.	FLANGED		No	-	-
S	SEWER	BURIED EXPOSED	ALL	SDR 35 PVC	PUSH-ON	CLASS II	N/A		

- (1) PIPE CONTAINED WITHIN TANKAGE SHALL BE CONSIDERED "EXPOSED" OR "INTERIOR" PIPING FOR THE PURPOSES OF THE PIPE SCHEDULE (UNLESS OTHERWISE SPECIFICALLY DESIGNATED).
- (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 15062DUCTILE IRON PIPE & FITTINGS
(INTERIOR/EXPOSED APPLICATIONS)PART 1 - GENERAL1.1 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.
 - 3. Ductile Iron Pipe & Fittings for Buried Applications is specified in Section 02615.

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).
- B. Acceptable Manufacturers:
 - 1. Griffin
 - 2. Tyler
 - 3. Union
 - 4. US Pipe
 - 5. Victaulic Company (fittings only)
 - 6. Or equivalent.

1.3 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 - PRODUCTS2.1 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. A central fin not less than 1/2 inch thick and of 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 15070EMERGENCY GENERATOR EXHAUST PIPINGPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish and install the exhaust piping system and install exhaust equipment furnished with the emergency generator as shown on the Drawings.
- B. Related Work Specified Elsewhere: "Pipe and Pipe Fittings - General" is specified in this Division.
- C. Items to be provided with the Generator by the Supplier of the Generator:
 - 1. Flexible connection(s).
 - 2. Muffler(s).

PART 2 - PRODUCTS2.1 MATERIALS

- A. Exhaust Pipe and Fittings: Standard weight, Schedule 40 steel pipe with long radius welded, flanged, or screwed elbows.

PART 3 - EXECUTION3.1 INSTALLATION

- A. Install exhaust pipe and muffler as shown on the Drawings:
 - 1. Provide and install a condensate pocket and drain valve at the base of the rise from the generator.
 - 2. Provide and install a ventilated thimble through the roof with cover plates where shown on the Drawings. GT Exhaust 20-B or equivalent product.
 - 3. Provide and install a drain cock on the muffler when required or shown on the Drawings.
 - 4. Provide and install flashing and counter flashing where shown on the Drawings.
 - 5. Insulate muffler and pipe in accordance with the Insulation Section in this Division.
- B. Adequately support the muffler and piping to prevent any strain on the flexible connection.

3.2 START UP

- A. Startup emergency generator with the Engineer present to ensure that the exhaust pipe and muffler are properly sealed.
- B. Repair all leaks to the satisfaction of the Engineer.

END OF SECTION

SECTION 15088COUPLINGS & CONNECTORSPART 1 - GENERAL1.1 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 - PRODUCTS2.1 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 equivalent.
 - 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 equivalent.
- 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 equivalent.
- 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 equivalent.
 - 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 equivalent.
 - 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 equivalent.
- 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.

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 15092PIPE SLEEVES & SEALSPART 1 - GENERAL1.1 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 07900.
 - 2. Pipe and Pipe Fittings - General is specified in Section 15050
 - 3. 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.

PART 2 - PRODUCTS2.1 TYPES AND LOCATIONS

- A. 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 07900 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.
 - e. Refer to details on Process Drawings.
 - 2. 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 07900 for standard penetrations.
 - d. Refer to details on Process Drawings.
 - 3. 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.
4. Roof Penetrations - Air to Air:
- a. Same as “Interior Concrete Partitions” and as shown on the Drawings.
5. Exterior Concrete Walls - Air to Air; and Air to Ground:
- a. Schedule 40 galvanized steel pipe with 1 inch x 1/2 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.
6. 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 1/2-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 1/2-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 1/2-inch integrally cast sealing and anchoring collar in middle; or sleeve with 1-inch x 1/2-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.
7. Foundation Walls Below Grade (Frost Walls) - 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 07900 for standard penetrations.
 8. Other conditions shall be sleeved or as reviewed and accepted by the Engineer.
 - B. 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 07900 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 07900 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 (Frost Walls) - 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 (Frost Walls) - 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 07900 for standard penetrations.
 12. Other conditions shall be installed as reviewed and accepted by the Engineer.
- C. Pipe openings in and penetrations through precast concrete structures shall be as specified in Division 2 and 3.
- D. Rubber Link Compression Seals:
 1. Acceptable Manufacturers:
 - a. Link Seal by Thunderline Company

- b. Innerlynx by Advance Products and Systems
 - 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 by Thunderline Company are to establish type and level of quality.
 3. General Service (Model C):
 - a. Glass Reinforced Nylon Pressure Plate.
 - b. Carbon steel zinc-phosphated 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. 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.
 6. Refer to details on Process Drawings.
- E. 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 15094PREFABRICATED PIPE HANGERS, SUPPORTS AND BRACINGPART 1 - GENERAL1.1 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 03300 - Cast-in-Place Concrete
- B. Section 05500 – Miscellaneous Metals
- C. Section 09900 – Painting
- D. Division 11 – Equipment
- E. Section 15050 – Pipe and Pipe Fittings – General
- F. 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 pipe supports shall meet the following requirements:
1. Anchors shall have a minimum of 2 anchors per hanger.

2. Anchors shall be sized to provide a Factor of Safety of 5 on the manufacturer's ultimate capacity of the anchor.
 3. Anchors shall have a minimum embedment depth of 6 inches, minimum spacing of 6 inches and a minimum edge distance of 6 inches.
- 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. Refer to the Structural Drawings for wind design parameters
 7. Snow Load – In accordance with ASCE 7. Refer to the Structural Drawings for snow design parameters
 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; 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. 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

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- 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. Wet well Room
- 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
 - 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)

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- 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. Type 1 pipe hangers installed in concrete overhead shall utilize the following anchorage:
 1. All connections shall utilize a minimum of 2 anchors.
 2. All drilled anchors shall have a minimum embedment depth of 6 inches, minimum concrete edge distance of 6 inches and minimum spacing of 6 inches.
 3. 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 15100VALVES & SPECIALTIES – GENERALPART 1 - GENERAL1.1 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. Shop preparation and shop coatings.
- 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 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 valve tags shall be provided with identifying numbers and letters to match that as shown on the Drawings. All valve tags shall be provided with sufficient lengths of chain for attachment to the respective valve.
- B. 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 INSTALLATION

- A. 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.

- B. 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.
- C. Carefully erect all valves and support them in their respective positions free from distortion and strain.
- D. Independently support all valves connected to pumps and equipment, and in piping systems that cannot support valves.
- E. Repair any scratches, marks and other types of surface damage etc. with original coating as supplied by the factory.
- F. Install valves such that "open" and "close" position indicators are easily visible.
- G. 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.
- H. 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 15104PLUG VALVESPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish, install and test plug valves and actuators 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 and Specialties - General" is specified in this Division.

1.2 QUALITY ASSURANCE

- A. All plug valves of same type, style, and duty shall be of one manufacturer.
- B. All actuators shall be supplied by the valve manufacturer who shall be responsible for proper operation of all valves with the actuators specified.
- C. Acceptable Manufacturers:
 - 1. DeZurik Corporation
 - 2. Clow
 - 3. Val-Matic
 - 4. Or equivalent.

1.3 JOB CONDITIONS

- A. Piping as shown on the Drawings is detailed to accommodate standard design flanged plug valves having face-to-face dimensions of standard flanged gate valves.
- B. Make all necessary adjustments to piping, subject to review of the Engineer, to accommodate plug valves furnished with face-to-face dimensions not of standard flanged gate valves.
- C. Valves 2 inches and smaller may be of screwed type unless indicated otherwise.

PART 2 - PRODUCTS2.1 MATERIALS

- A. Two Way Valves:
 - 1. Non-lubricated, eccentric type, cast iron body with end type as shown on the Drawings.
 - 2. Shall have an unobstructed shaped waterway, when open, of not less than 80% of nominal pipe area.
 - 3. Body shall be of gray cast iron, ASTM A126 Class B with resilient plug facings of neoprene or Buna-N.
 - 4. Packing shall be Buna-N with a maximum temperature of 350 F. Packing shall be manually adjustable.
 - 5. Bearings shall be stainless steel or bronze as required.
 - 6. Suitable for particular service in piping in which installed.
 - 7. Welded-in nickel or stainless steel seat.
 - 8. Shall have drop-tight shut-off.
- B. Actuators (type as shown on the Drawings and specified herein):

1. Lever Actuators:
 - a. Size and length as required with a 2 inch square socket end for use on 2 inch square actuating nut.
 - b. Attach handle to valve with a 4 foot length of chain.
 - c. Use for valves 6-inches and smaller.
- C. Accessories (When Applicable):
 1. Extension (for lever actuated valves):
 - a. Shall include extension pipe, bearing plate and couplings of the sizes as required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. In accordance with Section 15100.
- B. For horizontal piping, install valves with stems horizontal such that the plug in upper part of the body when in the open position and such that the plug is in the upstream end of the body when in the closed position. Coordinate valve orientation with the Engineer.

END OF SECTION

SECTION 15106BALL VALVESPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish, install and test ball 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 and Specialties - General" is specified in this Division.

1.2 QUALITY ASSURANCE

- A. All ball valves of same type, style, and duty shall be of one manufacturer.
- B. Acceptable Manufacturers:
 - 1. WKM Div. of ACF Industries
 - 2. Rockwood Ball Valves (E.W. Bliss Co.)
 - 3. Or equivalent.

PART 2 - - PRODUCTS2.1 MATERIALS

- A. General Services:
 - 1. Ball valves shall be of the non-lubricated free-floating ball type suitable for service in sludge piping.
 - 2. Port areas shall be full-bore (free area through valve not less than inside area of a pipe of the nominal valve size).
 - 3. Bodies shall be of carbon or semi-steel suitable for 200 psi. water working pressure.
 - 4. Balls shall be made of steel, precision machined, and chrome plated.
 - 5. Valves shall be capable of seating in both directions. Seats shall be made of teflon or other acceptable material. Valves shall use upstream line pressure for effectively seating the valve.
 - 6. Stem packing shall be manually adjustable under pressure and of suitable material for the intended service.
 - 7. Ball valves larger than 2½ inches shall have flanged ends faced and drilled in accordance with 125-lb. AN Standard.
 - 8. Ball valves 2½ inches and smaller shall have screwed ends.
- B. Actuators (type as shown on the Drawings and specified herein):
 - 1. Lever Actuators: Size and length as required with a 2 inch square socket end for use on 2 inch square actuating nut. Attach handle to valve with a 4 foot length of chain.
 - 2. Handwheel Actuators:
 - a. Totally enclosed gear type.
 - b. Sized for the operating conditions encountered.

- c. Use on all valves 8 inches in size and larger, and on smaller valves when valve location does not allow lever actuator.
- d. Valve position indicator required.
- C. Accessories (When Applicable):
 - 1. Extension (for lever actuated valves):
 - a. Shall include extension pipe, bearing plate and couplings of the sizes as required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install valves in accordance with the "Valves and Specialties - General" Section in this Division.

END OF SECTION

SECTION 15110CHECK VALVESPART 1 - GENERAL1.1 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.
- C. Requirements Specified Elsewhere: Additional requirements that affect the work of this Section are specified elsewhere including, but not limited to General Conditions, Supplementary Conditions and:
 - 1. Section 01340 - Submittals
 - 2. Section 01400 - Quality Control
 - 3. Section 01800 - Equipment Startup, Certification and Operator Training
 - 4. Section 09905 - Surface Preparation and Shop CoatingsThe General Contractor is responsible for conveying the appropriate information from these sections to the supplier.
- D. Related Work:
 - 1. Field painting is specified in Section 09900.
 - 2. Section 15100 – Valves & Specialties - General

1.2 QUALITY ASSURANCE

- A. All check valves of same type and duty shall be by one manufacturer.

PART 2 - PART 2 - PRODUCTS2.1 SWING TYPE CHECK VALVES

- A. The check valve shall conform to the materials of construction, pressure rating and test requirements of AWWA C508 and be suitable for installation in a horizontal or vertical flow up pipe.
- B. The body shall be made of cast iron conforming to ASTM A126 Class B with a bolted steel cover allowing complete access to and removal of all internal components while the valve is in the line.
- C. The valve body shall have integral flanges, flat faced and drilled per ANSI B16.1 Class 125 or Class 250, as required.
- D. The valve body shall have a removable Type 316 stainless steel body seat held in place with stainless steel pins.
- E. The disc arm shall be ductile iron and the disc shall be cast iron with a replaceable Buna-N (or other suitable material) disc seat held in place by a type 316 stainless steel follower ring and stainless steel screws. The disc shall be attached to the disc arm by means of a center pin, disc nut and washer providing 360 degree angular articulation but not rotate.
- F. The disc arm shall be suspended from and keyed to a stainless steel shaft that is

- supported at each end by stainless steel or no-lead bronze bushings. The shaft shall rotate freely without the need for external lubrication. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing.
- G. Bosses shall be provided on check valves which may be tapped for draining or used for by-pass. The inside and outside of all valves together with the working parts, except bronze and machined surfaces, shall be coated in accordance with AWWA C-550.
 - H. Marking shall be in accordance with AWWA C-508 and shall include size, working pressure, and cast arrow to indicate direction of flow, name of manufacturer, and year of manufacture.
 - I. The valve shall be supplied with an outside lever and adjustable counterweight. The lever and weight shall be on the right hand side of the valve (looking in the direction of flow) but shall be field convertible to the left hand side without additional parts. Fitted with an adjustable dashpot or snubber to control speed of valve closure.
 - J. The valve shall also be provided with a single, side mounted air-cushion assembly directly mounted to the valve body. The amount of cushioning shall be adjustable without the need for pre-charged air chambers.
 - K. Acceptable Manufacturers:
 - 1. Val-Matic Series 7800LW
 - 2. GA Industries Figure 220
 - 3. Or Engineer approved equal.

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 15180PIPE AND EQUIPMENT INSULATIONPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Provide and apply insulation to emergency generator exhaust pipe and muffler.
- B. Related Work Specified Elsewhere: "HVAC General", and "Emergency Generator Exhaust Piping" are specified in this Division.

1.2 QUALITY ASSURANCE

- A. Standards:
 - 1. Mineral fiber high temperature pipe insulation shall conform to ASTM C547 Type II.
- B. Have all insulation work performed by skilled insulation workmen regularly employed in the trade.
- C. Fire Hazard Rating: Except for materials listed below, all insulation materials, adhesives, coatings and other accessories shall have a UL fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed. Exceptions are:
- D. Acceptable Manufacturers:
 - 1. High temperature mineral fiber:
 - a. Owens-Corning
 - b. Knauf
 - c. Certainteed
 - d. or equal

PART 2 - PRODUCTS2.1 MATERIALS

- A. Emergency Generator Exhaust Pipe and Muffler and Boiler Breaching.
 - 1. High temperature mineral fiber.
 - 2. Thickness: 2 inches.
 - 3. Covering: 16 oz. fiberglass lagging cloth.
 - a. Prime surface with lagging sealer adhesive.
 - b. Embed the fiberglass lagging cloth in the sealer adhesive.
 - c. Top coat the lag cloth with sealer.
- B. Fittings and Valves:
 - 1. Mineral fiber insert insulation with an aluminum pre-molded fitting cover.
 - 2. Do not insulate unions and flanges.

PART 3 - EXECUTION3.1 INSTALLATION

- A. Apply insulation only after all pipes have been tested and approved.

- B. Clean and dry all surfaces to which insulation is to be applied.
- C. Neatly finish the ends of insulation on exposed piping at valves, flanges, etc., with cover strips.
- D. Insulation at Hangers:
 - 1. Insulation shall be continuous at hangers.
 - 2. Provide protection saddles at pipe hangers where required to prevent compression or distortion of insulation in accordance with insulation manufacturer's requirements.

3.2 CLEANING

- A. Clean all insulation of accumulated paint, concrete, mortar, etc.
- B. Do not damage insulation during cleaning.

END OF SECTION

SECTION 15540PORTABLE FIRE EXTINGUISHERSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish and install portable fire extinguishers where shown on the Drawings and specified herein.

1.2 QUALITY ASSURANCE

- A. Codes, Regulations and Standards:
1. National Fire Protection Association.
NFPA10 Portable Fire Extinguishers.
 2. Underwriters Laboratories, Inc.
- B. Acceptable Manufacturers:
1. Amerex Corp.
 2. Kidde
 3. Or equal

1.3 SUBMITTALS TO THE ENGINEER

- A. General: Submittals shall be in accordance with specification Section 01340.

PART 2 - PRODUCTS2.1 MATERIALS

- A. General: The following models are Amerex to establish type and quality.
- B. Dry Chemical Extinguishers:
1. U.L. approved and rated for Class A, B, and C fires. DOT-ICC cylinder.
 2. Heavy duty brass valve, one-hand squeeze grip operation, safety pull pin.
 3. Pressure gauge.
 4. Flexible discharge hose and nozzle.
 5. Wall-mounting bracket
 6. Fully charged with multi-purpose "ABC" dry chemical and pressurized.
 7. Stamped with hydrostatic test date.
 8. 20-lbs capacity.
 9. Equal to Amerex 423.

PART 3 - EXECUTION3.1 INSTALLATION

- A. Mounting: Mount on wall at locations shown on the Drawings. Attached mounting hook or bracket to wall with approved expansion shields or toggle bolts. Mount top of extinguishers at or about 36" above finish floor maintaining a minimum 4" clearance between bottom of the extinguisher and the finish floor.
- B. Identification: Provide wall markers in readily visible location above extinguishers. Markers to be painted metal or decals complying with NFPA Standard No. 10 for fire

classification of extinguisher.

C. 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 15600HVAC - GENERALPART 1 - GENERAL1.1 DESCRIPTION

A. Work included:

1. Furnish all labor, materials, equipment and transportation as required to completely install the heating and ventilation system as shown on the Drawings and as specified herein.
2. The heating and ventilating work shall include, but not be limited to the following:
 - a. Heat generation and transfer equipment.
 - b. Ductwork and devices.
 - c. Air moving and air handling equipment.
 - d. Automatic temperature control systems.
 - e. Pipe and equipment insulation.
 - f. Balancing air systems.
 - g. Connections to equipment installed by other trades.
 - h. Installation of components and devices furnished by other trades that are located in Heating and Ventilating piping, ducts, or equipment.

B. Related Work Specified Elsewhere (When Applicable) :

1. Excavation and backfill is specified in Division 2.
2. Concrete is specified in Division 3.
3. Structural steel is specified in Division 5.
4. Painting is specified in Division 9.
5. All equipment shall comply with Specification Section 11000, Equipment General.
6. Pipe Sleeves and Seals are specified in Section 15092.
7. Pipe Hangers and Supports are specified in Section 15094.
8. Pipe, insulation, ductwork, dampers, fans, etc., are specified in the appropriate Sections in this Division.
9. Electrical Work:
 - a. 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.
 - b. 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.
 - c. 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.

- C. Design Criteria: The Drawings do not show every detail of pipe, valves, fittings, hangers and equipment which are necessary for the complete installation, but are provided to show the general arrangement and extent of work to be performed.

1.2 SUBMITTALS TO THE ENGINEER

- A. Submit shop drawings as specified in the General Conditions of the Construction Contract and as stated in each Section.
- B. Submit manufacturer's installation, operation, and maintenance information for all mechanical equipment as specified in the General Conditions. Information shall consist of, but not be limited to, the following:
 - 1. Manufacturer's operation & maintenance manuals.
 - 2. Parts List.
 - 3. Address of local suppliers for parts.
 - 4. Address of local factory approved service organizations.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the care and protection of all materials and mechanical work until the project is accepted by the Owner.
- B. 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 safig, 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 unit isolation and alignment to adjacent inlet and outlet interconnecting piping and/or ductwork including but not limited to; manual air vents, shutoff valves, unions and drains with valves. 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 EQUIPMENT AND VALVE TAGS

- A. All new plumbing and HVAC (Mechanical Systems) equipment shall be identified by a color coded equipment/valve tag, provided and installed by the Contractor. Contractor shall submit a complete list of proposed Identification Tag information and it shall be reviewed by the Engineer and Owner and revised as indicated. In general, tag information shall match the information provided on the Drawings.
- B. 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 stainless steel 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.

2.3 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:
 - 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 submerged applications, including but not limited to the 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all work with a neat and orderly appearance, as specified and as shown on the Drawings.

- B. Make all installations structurally sound throughout.
- C. Locate all installations to avoid interference with cranes and materials handling equipment, storage areas, work of other trades, and traffic areas.
- D. 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 workmen regularly employed in the applicable trades.

3.2 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.

3.3 BALANCING

- A. Requirements: Adjust all systems and components to perform as required by the Drawings and Specifications.
- B. 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.
- C. Apply all instruments in accordance with manufacturer's instructions and recommendations.
- D. Provide all labor, instruments and appliances required.
- E. 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. Acceptable values shall be within ± 10 percent of values listed on the Drawings.
- F. 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.
- 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.

3.4 IDENTIFICATION

- A. All HVAC piping, valves, pumps and equipment shall be painted and labeled in accordance with Specification Section 09900 or as specified herein.
- B. Signage is specified in Section 10010.

END OF SECTION

SECTION 15604AUTOMATIC TEMPERATURE CONTROL (ELECTRIC)PART 1 - GENERAL1.1 DESCRIPTION

- A. Furnish, install and test an Automatic Temperature Control (ATC) system of the type and function required on the Drawings and as herein specified.
 - 1. Type of System: Electric.
- B. Related Work Specified Elsewhere: "HVAC - General" is specified in this Division. "Cabinets and Enclosures" is specified in Section 16160.
- C. Other Trades: The automatic temperature control trades shall coordinate and supervise other trades whose work affects the control systems.
- D. 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.

1.2 QUALITY ASSURANCE

- A. The system shall be installed, tested, and balanced by competent mechanics regularly employed by the temperature control manufacturer.
- B. Acceptable Manufacturers:
 - 1. Honeywell.
 - 2. Johnson Service Co.
 - 3. MCC Powers
 - 4. Barber-Coleman
 - 5. Robertshaw
 - 6. or equal

1.3 SUBMITTALS TO THE ENGINEER

- A. Shop drawings shall be submitted for approval as required by the General Conditions. Shop drawings shall consist of, but not be limited to, the following:
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 layouts for all local and central panels, and panel sizes.
 5. Valve and damper operator schedule showing size, configuration, capacity and location of all equipment.
 6. A detailed explanation of any control system that is different, or will function differently than that specified.

1.4 JOB CONDITIONS

- A. Scheduling of Work: Schedule all work so as not to delay the work of other trades.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General:
1. The control system shall consist of all thermostats, temperature transmitters, controllers, automatic valves and dampers, damper operators, control panels, and other accessory equipment to fill the intent of the specification and provide for a complete and operable system.
 2. All 24 volt control wiring shall be provided by the automatic temperature control contractor as shown or required to provide a complete system.
 3. Refer to Drawings for electrical wiring and interlocks.
 4. All panels and devices shall meet the NEMA electrical classification of the space in which they are installed. See Drawing Sheet E-1 for NEMA schedule.
- B. Industrial Temperature Controller:
1. Furnish and install 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.
 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. Equivalent to:
 - a. Honeywell Model T775
 - b. Or equal
- C. Dampers:
1. All control dampers shall be furnished as part of Section 15862.
 2. All dampers shall be installed by sheet metal trades.
- D. 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.
- E. 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.
- F. 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.
- G. 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.
- H. Panels:
1. Panels shall be provided to enclose all relays, switches, and controllers as required.
 2. Required indicating and control devices shall be installed in the cover.
 3. Terminal strips shall be provided for all electrical connections.
 4. Panels shall be central and/or local as indicated or required.
 5. Control Panels shall be provided in accordance with Section 16160 and NEMA schedule on drawing sheet E-1.

PART 3 - EXECUTION

3.1 DESCRIPTION OF OPERATION

- A. Electric Unit Heaters (EUH):
1. Wall mounted or integral thermostat provided with unit shall energize the heating coil and fan as necessary to maintain the space temperature setpoint.
 - a. Space temperature setpoint – 50°F (adj.)
- B. Exhaust Fan (EF-1):
1. Controlled by the following associated with ATC-1:
 - a. Hand/Off/Auto switch
 - b. Run cycle timer
 - c. Light switch interlock
 2. When the lights in the space are energized or the switch is in the “Hand” position:
 - a. Fan shall be energized.
 - b. Intake damper D-3 shall open.
 3. When the lights in the space are de-energized, the fan shall be controlled by the run cycle timer on repeating schedule:
 - a. Active:
 - i. Fan shall be energized.
 - ii. Intake damper D-3 shall open.
 - b. Inactive:
 - i. Fan shall be de-energized.
 - ii. Intake damper D-3 shall close.
 - c. Active - 10 minutes; Inactive - 20 minutes (adj.)
- C. Ductless Split System Heat Pump System (DS-1 & HP-1)
1. System controls shall be packaged controls provided by the manufacturer.
 - a. Cooling setpoint – 85°F (adj.)
 - b. Heating setpoint – 50°F (adj.)
- D. Emergency Generator Dampers (D-1 & D-2)
1. Wiring and controls by electrical contractor.

3.2 INSTALLATION

- A. The automatic temperature control mechanics shall provide supervision and direction for all trades that are installing equipment supplied by the temperature control manufacturer.
- B. All controllers, wiring, equipment, etc., shall be installed by mechanics regularly employed by the temperature control manufacturer.
- C. Control wiring shall be neatly installed, parallel to building lines, and in locations not subject to damage.

3.3 TESTING AND COMPLETION

- A. Demonstrate the function of each system in the presence of the Engineer.
- B. Upon completion of the project, the control system provider shall:
 - 1. Completely adjust, ready for use, all thermostats, controllers, valves, damper operators, relays, etc., provided under this Section.
 - 2. Furnish three (3) instruction manuals covering the function and operation of the control systems on the project for the use of the Owner's operating personnel. A representative of the ATC systems provider shall be available on site for 8 hours of start-up and shall conduct an operational test of the system in the presence and satisfaction of the Engineer's designated representative and the Owner's representative. During this 8-hour period, the technician shall instruct the Owner's Representatives in the proper use and routine maintenance of all ATC equipment.

3.4 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.

3.5 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.

3.6 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.

3.7 PROGRAMMED MAINTENANCE

A. Upon completion of the installation, the 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.

ATC SYSTEM TRAINING CERTIFICATION

Owner: _____ Date: _____

Project: _____

Contractor: _____

ATC System Provider _____
Representative: _____

Equipment: _____

- 1. I have trained the Owner's personnel in the proper operation and maintenance of the above equipment.

(Authorized Representative of the ATC System Provider) (Date)

- 2. The personnel listed below attended the training session.

(Owner's Representative) (Date)

- 3. Witnessed by

Wright-Pierce (Date)

Wright-Pierce
Engineers
99 Main Street
Topsham, ME 04086

END OF SECTION

SECTION 15671DUCTLESS SPLIT SYSTEM HEAT PUMP UNITSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish and install ductless split system heat pump systems of the size and capacities as shown on the drawings. Each unit shall include an outdoor condensing unit, high wall mounted direct expansion fan coil unit, refrigeration specialties, refrigerant charge and wireless remote control.
- B. Related Work Specified Elsewhere.
 - 1. "HVAC - General" is specified in this Division.

1.2 QUALITY ASSURANCE

- A. Each system shall be rated and certified in accordance with ARI Standards 210/240 and 270. Components shall be listed in the ARI directory as matched sets (systems).
- B. Unit construction shall comply with ANSI/ASHRAE 15, latest revision, the NEC and be constructed in accordance with UL standards and shall carry the UL label of approval.
- C. Steady state energy efficiency ratio (EER) of 12.0 minimum.

PART 2 - PRODUCTS2.1 MATERIALS

- A. Condensing Unit
 - 1. Unit Cabinet:
 - a. Unit cabinet shall be constructed of galvanized steel, bonderized, and coated with baked-enamel finish on inside and outside.
 - b. Unit access panel should be removable with minimal screws and shall provide full access to the compressor, fan, and control components.
 - c. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.
 - 2. Fans:
 - a. Outdoor fans shall be direct-drive propeller type, and shall discharge air horizontally. Fan shall draw air through the outdoor coil.
 - b. Outdoor fan motors shall be totally-enclosed, single phase motors with class B insulation and permanently-lubricated ball bearings. Motor shall be protected by internal thermal overload protection.
 - c. Shaft shall have inherent corrosion resistance.
 - d. Outdoor fan openings shall be equipped with PVC metal/mesh coated protection grille over fan.
 - 3. Compressor:
 - a. Compressor shall be fully hermetic variable speed rotary type.
 - b. Compressor shall be Three phase, inverter driven.

- c. Compressor shall be equipped with oil system, operating oil charge, and motor.
 - d. Motor shall be NEMA rated class F, suitable for operation in refrigerant atmosphere.
 - e. Compressor assembly shall be installed on rubber vibration isolators.
 - f. The inverter and compressor shall be protected against over temperature and over current.
4. Outdoor Coil:
Coil shall be constructed of Aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated and sealed.
 5. Refrigerant Components:
Refrigerant circuit components shall include brass external liquid line service valve with service gauge port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader type fittings with brass caps, accumulator, reversing valve.
 6. Safeties:
Operating safeties shall be factory selected, assembled, and tested. The minimum functions shall include the following:
 - a. Compressor discharge over temperature protection.
 - b. System low voltage protection.
 - c. Compressor overload protection.
 - d. Compressor over current protection.
 - e. IPM module protection.
 7. Electrical Requirements:
 - a. Units shall operate on single-phase, 60 Hz power at 115 v.
 - b. Unit electrical power shall be a single point connection.
 - c. All power and control wiring must be installed per NEC and all local electrical codes.
 - d. Units shall have high and low-voltage terminal block connections.
- B. Ductless Fan Coil Unit (DS-1)
1. Unit Cabinet:
 - a. Cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal acoustic performance.
 2. Fans:
 - a. Fan shall be tangential direct-drive blower type with air intake at the top of the unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be provided standard.
 - b. Air sweep operation shall be useable selectable. The vertical sweep may be adjusted (using the remote control) and the horizontal air direction may be set manually.
 3. Coil:
 - a. Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip

DUCTLESS SPLIT SYSTEM HEAT PUMP UNITS

- pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap.
4. Motors:
 - a. Motors shall be open drip-proof, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be 3-speed.
 5. Controls:
 - a. Controls shall consist of a microprocessor-based control system which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 50°F to 85°F.
 - b. The unit shall have the following functions as a minimum:
 - i. Automatic restart after power failure at the same operating conditions as at failure.
 - ii. A timer function to provide a minimum 24-hour timer cycle for system Auto Start/Stop.
 - iii. Temperature sensing control to enter set points and operating conditions.
 - iv. Wired remote controller to enter set points and operating conditions.
 - v. Automatic air sweep control to provide on or off activation of air sweep louvers.
 - vi. Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.
 - vii. Fan-only operation to provide room air circulation when no cooling is required.
 - viii. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.
 - ix. Fan speed controls shall be user-selectable: high, medium, low or microprocessor controlled automatic operation during all operating modes.
 - c. The unit shall be protected against the following:
 - i. Indoor coil freeze-up.
 - ii. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature when unit is in heat pump mode.
 6. Filters:
 - a. Units shall have filter track with factory-supplied cleanable filters.
 7. Refrigerant Lines:
 - a. Use manufacturer's recommended refrigerant piping.
 - b. All units should have refrigerant line connections that can be oriented to connect from the left, right, or back of unit. Both refrigerant lines shall be insulated.
 8. Systems shall be:
 - a. Mitsubishi
 - b. Daikin
 - c. Or approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All system components shall be installed in strict accordance with the manufacturer's instructions, recommendations and as shown on the Drawings.

3.2 STARTUP, TESTING, AND TRAINING

- A. Provide startup, testing and training in accordance with the requirements of Section 01800.

END OF SECTION

SECTION 15766ELECTRIC UNIT HEATERSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish and install electric unit heaters as shown on the Drawings and as specified except electric wiring.
- B. Related Work Specified Elsewhere:
 - 1. Mechanical is specified in the appropriate Sections of this Division.
 - 2. Electrical wiring is specified in Division 16 and will be done by the Electrical Subbidder.
- C. Other Trades: Cooperate with other trades whose work is to be coordinated with electric unit heaters.

1.2 QUALITY ASSURANCE

- A. Standards and Codes:
 - 1. Underwriters' Laboratories, Inc.
 - 2. National Electric Code.
- B. Acceptable Manufacturers:
 - 1. Indeco.
 - 2. Markel.
 - 3. Chromalox.
 - 4. Trane.
 - 5. Berko.
 - 6. Or approved equal.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit shop drawings, manufacturer's literature, maintenance data and operating instructions as specified in 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 heaters to prevent damage of any nature.

PART 2 - PRODUCTS2.1 MATERIALS

- A. Unit Heaters:
 - 1. Capacities as shown on the Drawings.
 - 2. Mounting accessories as shown on the Drawings.
 - 3. Individually adjustable discharge louvers.
 - 4. Fin tube metal sheathed, steel or cast aluminum heating elements.
 - 5. Automatic reset thermal overheat protection.

6. Totally enclosed continuous fan-duty type fan motor with built-in thermal overload protection.
 7. Aluminum, propeller-type fan.
 8. Steel cabinet with standard finish.
 9. Magnetic contactor mounted and wired in cabinet.
 10. Fused control transformer when required for thermostat or fan operation.
 11. Wall thermostat.
- B. Explosion Proof Corrosion Resistant Unit Heaters:
1. Capacities as shown on the Drawings.
 2. Mounting accessories as shown on the Drawings.
 3. Heater to be forced fan type of the kW rating, voltage and phase specified in the schedule. Factory Mutual and CSA Approved for: Class I, Divisions 1 and 2, Group D.
 4. Finned tubular heating elements shall be of type 304 stainless steel sheath with mechanically wound stainless steel fins and mounting fittings.
 5. The motor shall be totally enclosed with permanently lubricated ball bearings, designed to resist moisture and corrosion, fitted with an epoxy-coated aluminum fan blade and factory wired to NEMA 7, 9 enclosure.
 6. Heating elements and motor to be enclosed in round, heavy 16 gauge stainless steel shroud, with stainless steel louvered outlet grille and plated rear grille.
 7. Single point, line voltage connection for incoming power.
 8. NEMA 7, 9 cast aluminum enclosure with a threaded bottom cover to house element terminals and the following standard built-in controls: primary automatic reset and secondary manual reset overtemperature cutouts, fan delay relay, required contactors, and terminal block for field wiring. Provide with disconnect switch.
 9. Thermostat shall be furnished with each heater for remote wall mounting. Thermostat shall be UL Listed with NEMA 7,9 enclosure suitable for Class 1, Div. 1 areas.

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 15820VENTILATION FANSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Provide and install ventilation fans of the types and arrangement as shown on the Drawings and as specified herein.
- B. Related Work Specified Elsewhere "HVAC - General" is specified in this Division. "Electrical-General" is specified in Section 16010.

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 - PRODUCTS2.1 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. Integral thermal overload protection on single phase fractional horsepower motors

- 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. Centrifugal Sidewall Exhauster:
 - 1. Acceptable Manufacturers:
 - a. Greenheck Fan Corp.
 - b. Loren Cook, Co.
 - c. PennBarry
 - d. Or approved equal.
 - 2. Windband shall be of heavy gauge aluminum with rolled bead on outer edge. Construction shall be designed so that entire unit can be serviced from exterior of the building.
 - 3. Fan wheels: backward curved centrifugal fabricated from aluminum, non-overloading, statically and dynamically balanced.
 - 4. Belt or direct driven as noted with all drive components mounted on vibration isolators.
 - 5. Gravity backdraft damper supplied unless motorized damper is required and noted on drawings.
 - 6. Aluminum bird screen provided.

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 15862DAMPERSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Provide and install dampers and accessories where shown on the Drawings.
- B. Related Work Specified Elsewhere:
 - 1. "HVAC General" is specified in this Division.
 - 2. Electrical is specified in Division 16.
 - 3. Combination louvers and dampers are specified in Section 15869.

1.2 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
 - 1. Greenheck
 - 2. Air Balance, Inc.
 - 3. Airstream
 - 4. Louvers & Dampers, Inc.
 - 5. Ruskin.
 - 6. Or equal.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit shop drawings in accordance with the General Conditions of the Construction Contract.

1.4 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 - PRODUCTS2.1 MATERIALS

- A. Motor Operated Air Control Dampers:
 - 1. Material to match ductwork material in space installed.
 - 2. Control Dampers - Galvanized:
 - a. Equal to Greenheck VCD-23 control damper.
 - b. Frame:
 - i. 16 ga. galvanized steel formed into a 5" x 1" structural hat channel
 - ii. Top and bottom frame members on dampers less than 17" high shall be low profile design to maximize free area.
 - iii. 4-piece construction with minimum 1-1/2" integral overlapping gusset reinforcements in each corner to assure square corners and resist racking.
 - c. Blades:
 - i. Parallel or opposed blade as indicated.

- ii. 16 ga. galvanized steel strengthened by three longitudinal 1" deep V grooves running the entire length of each blade.
 - iii. Provide symmetrical blades of varying size as required to completely fill the damper opening.
 - iv. Blade orientation shall be horizontal.
 - d. Fully gasketed with a maximum allowable leakage of 8 cfm per square foot of face area at 4 inches W.C. differential pressure.
 - e. Bearings and blade shafts shall be non-corrosive.
 - 3. Control Dampers – Aluminum:
 - a. Equal to Greenheck VCD-43 control damper.
 - b. Frame:
 - i. Aluminum frame formed into a 5" x 1" structural hat channel
 - ii. Top and bottom frame members on dampers less than 17" high shall be low profile design to maximize free area.
 - iii. 4-piece construction with minimum 1-1/2" integral overlapping gusset reinforcements in each corner to assure square corners and resist racking.
 - c. Blades:
 - i. Parallel or opposed blade as indicated.
 - ii. Extruded airfoil shaped, aluminum construction with metal blade to metal blade overlap.
 - iii. Provide symmetrical blades of varying size as required to completely fill the damper opening. Blade orientation is horizontal.
 - d. Fully gasketed with a maximum allowable leakage of 8 cfm per square foot of face area at 4 inches W.C. differential pressure.
 - e. Bearings and blade shafts shall be non-corrosive.
- B. Damper Operators:
 - 1. Manual operators: Chrome plated locking quadrant supplied by damper or louver manufacturer. Provide with standoff brackets as necessary.
 - 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. Provide NEMA rated operators or enclosures to match space in which the damper operator is installed (refer to NEMA classification schedule on sheet E-1).
- C. Miscellaneous Connecting Sheet Metal:
 - 1. Galvanized steel or aluminum 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. Insure all blades open, close, and seal properly.
- C. Adjust weights on backdraft dampers.

END OF SECTION

SECTION 15869LOUVERSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Provide and install louvers and accessories where shown on the Drawings.
- B. Related Work Specified Elsewhere (When Applicable):
 - 1. Caulking and flashing are specified in Division 7.
 - 2. Sheet metal ductwork, air devices, automatic temperature control, etc., are specified in the appropriate Sections in this Division.
 - 3. Electrical is specified in Division 16.

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. Greenheck
 - 2. Ruskin Mfr. Co.
 - 3. Air Balance, Inc.
 - 4. Louvers & Dampers, Inc.
 - 5. American Warming and Ventilating, Inc.
 - 6. Airstream Inc.
 - 7. Or equal.

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. 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, 0.100" 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 width.
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 16010ELECTRICAL - GENERALPART 1 - GENERAL1.1 DESCRIPTION

- A. Provide all labor, materials, equipment, operations, methods and procedures 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 Architectural, Structural, Heating and Ventilating, Plumbing, Process Piping and Instrumentation Drawings to coordinate material and equipment locations and electrical requirements.
 - 2. Applicable portions of DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS together with DIVISION 1 - "GENERAL REQUIREMENTS", are part of DIVISION 16.
 - 3. Refer to SECTION 00100 - INSTRUCTIONS TO BIDDERS; SECTION 00700 - GENERAL CONDITIONS; SECTION 00800 - SUPPLEMENTARY CONDITIONS; and as specified herein regarding substitutions of materials and equipment.
 - 4. Definitions indicated in the "GENERAL CONDITIONS", "SUPPLEMENTARY CONDITIONS", "INSTRUCTIONS TO BIDDERS" and "SUPPLEMENTARY INSTRUCTIONS TO BIDDERS" are part of DIVISION 16, unless otherwise noted.
- F. Division 16 Contract Requirements and Responsibilities:
 - 1. The requirements of Division 16 - Electrical is based on the information provided in the Contract Documents. This information has been outlined in either the specifications or the drawings or both. The contractor's responsibility of Division - 16 Electrical is to review all information in both the specifications and the drawings in order to determine the complete work required. Whether the work is specified in the Specifications or shown on the Drawings it is required as part of the work. No additional compensation or interpretations stating that it was not shown in both locations will be acceptable or allowed.
- G. 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. This contractor is responsible to be familiarized with the conditions of the project during the bidding period in order to bring any clarifications or issues to the attention of the Engineer prior to submission of his/her final bid price.

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 limited to the following:
 - a. Provide Electrical Service and Distribution Systems as indicated on the "Single-Line Diagrams", related drawings and schedules, and as specified herein. There is a significant amount of electrical demolition and reconnection of equipment to remain for the work required for this project and therefore a thorough understanding of the existing conditions is critical. It is to be understood that the drawings do not intend to show or provide details for all of the existing conditions or equipment to be demolished. In addition, not all existing condition information may reflect exact conditions due to the accuracy of existing data and information. As an example, there are a significant number of existing branch circuit panelboards which have been listed and shown for this project. The existing panelboard schedules have been shown and noted as could be determined or as noted on existing information. The Contractor's responsibility is to field investigate and determine all existing conditions. Any and all existing equipment which is found to remain shall be reconnected to new panelboards with new conduit and wiring of equal sizing and conditions which presently exists in order to provide a complete system reconnection. No exception will be allowed for any extra compensation to perform this work. This contractor is responsible to be familiarized with the conditions of the project during the bidding period in order to bring any clarifications or issues to the attention of the Engineer prior to submission of his/her final bid price.
 - b. Provide complete lighting system(s), including all necessary fixtures, hangers, wiring, connections, controls and lamps for areas as shown on the Drawings and as specified herein.
 - c. Provide all required 480 Volt, 208 Volt, 240V, and 120 Volt Power and Control wiring, Signal wiring, grounding, and connections for equipment specified under DIVISIONS 11, 13, 14, and 15 except as indicated on the Drawings and specified herein.
 - d. Provide all required and supplemental motor starters, protective device sizes, wire and conduit sizes, holding coil voltages and control voltages specified under DIVISIONS 11, 13, 14, and 15. All rating and sizing shall match the requirements of equipment specified. No additional compensation will be allowed for modifications required due to equipment and devices which differ from those of specified equipment.
 - e. Provide complete branch circuit wiring systems including all raceways, conductors, cables, outlet and junction boxes, wiring devices and device connections as shown on the Drawings and as specified herein.

- f. Provide fire alarm system equipment as shown on the Contract Drawings and as specified herein.
 - g. Provide complete telephone communication system equipment and modifications as shown on the Drawings and as specified herein.
 - h. The electric utility company will be required to modify and relocated the existing incoming service as shown on the drawings. The Contractor shall provide, in addition to the utility company work, all required equipment, conduits, conductors, etc. for a complete new electrical service as noted on the Contract Drawings.
 - i. Provide complete demolition to the existing Emergency Standby Power System and furnish and install a completely new Standby Power System as specified and shown on the drawings.
 - j. Provide telephone service in areas as indicated on the drawings and as specified to include new telephone interface equipment and backboard.
- H. Work Specified Elsewhere:
- 1. The materials and methods used for all Electrical Work indicated in the Contract Documents shall meet the requirements specified in Division 16.
 - 2. The following Electrical Work and Work relating to the Electrical Work will be performed under other Divisions of the Contract Documents. This Contractor is to review all of the Contract Documents and Drawings and shall work closely with the other related areas which will affect his/her work under this Contract in order to avoid any and all conflicts:
 - a. Substitutions, product options, cleaning up and project record documents are specified in DIVISION 1.
 - b. Site work and excavation are specified in DIVISION 2.
 - c. Concrete Work DIVISION 3.
 - d. Metals are specified in DIVISION 5.
 - e. Firestops are specified in DIVISION 7.
 - f. Painting is specified in DIVISION 9.
 - g. Process equipment is specified in DIVISION 11
 - h. Special Systems and instrumentation is specified in DIVISION 13.
 - i. Conveying systems are specified in Division 14.
Mechanical equipment is specified in DIVISION 15.
- I. Removals and Relocations and Rearrangements:
- 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, relocations, rewiring and rearrangements 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. When the Contract Documents indicate elimination of, or structural changes in walls, floors, ceilings, enclosures, pipe chases, etc., remove, relocate, rearrange and reconnect as required, all existing Electrical Work such that systems to remain shall continue to function properly.

3. Provide in the Base Bid all associated labor, material and costs to include all removals, relocations, rewiring, rearrangements and reconnections herein specified, necessary or required to provide approved operation and coordination of the combined new and existing systems and equipment.
 4. Demolition:
 - a. Disconnect and remove existing equipment, devices, boxes, conduit, and associated electrical equipment as shown on the contract drawings.
 - b. Any demolition, relocation or rearrangement 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, relocation or rearrangements which results in unused openings in walls, ceilings, floors, etc. shall be sealed using approved methods to maintain the fire rating and NEMA classification of the existing structure.
 - d. 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 pullboxes, conduit, wiring and associated devices be disconnected, removed, relocated and in some cases, be replaced in order for the new equipment, walls, structures, etc. to be constructed and installed. In most cases, the detail of these existing conditions has not been shown. This Contractor will be responsible to perform all work necessary to demolish all required conduit, wiring, boxes and associated equipment for the noted and intended demolition. At no time shall this Contractor imply that he/she does not understand the responsibility of associated demolition as the Contractor shall visit the site locations and shall become familiar with the areas where this work is to be performed. If there are any concerns or issues regarding this work they 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 is 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 required under the work of this contract.
 - f. Disconnect and remove all abandoned conduits, wiring, boxes, equipment, controls, hangers, etc. shown or not shown, which is located within the area of construction under this contract.
 5. The Contractor is responsible for temporary power associated with Removals, Relocations, and Rearrangements to maintain the existing facility operational. Refer to section within this section for requirements.
- J. Codes and Fees:
1. Comply with the following codes, standards, regulations and specifications:

- a. National Electrical Code (N.F.P.A. No. 70 - most recent edition)
 - b. Life Safety Code (N.F.P.A. No. 101 - most recent edition)
 - c. Occupational Safety and Health Act (O.S.H.A.) - regarding construction practices.
 - d. Utility company standards, specifications and requirements.
 - e. Telephone company standards, specifications and requirements.
 - f. Cable company standards, specification and requirements.
 - g. State and local electrical codes, building codes, and fire codes for the locale where the work is to be performed.
 - h. N.F.P.A. 820 Standards for Fire Protection in Wastewater Treatment and Collection Facilities.
2. Compliance with the above codes, standards, etc., does not relieve the Contractor from the requirements of the Contract Documents which may exceed these codes, standards, etc. but which are not contrary to them.
 3. If it is observed that the Contract Documents are at variance with any of the above codes, standards, etc., promptly notify the Engineer in writing, and necessary changes shall be adjusted by appropriate modification. If any work is performed which is contrary to such codes, standards, etc., the Contractor shall assume full responsibility therefore and shall bear all costs in correcting such work in order to comply with such codes, standards, etc.
 4. Secure and pay for all permits, fees and licenses necessary for the proper execution of the work under DIVISION 16.
- K. Tests and Procedures Prior To Start-up:
1. Refer to Section 16950 - Testing Electrical Systems and start-up for testing and scheduling requirements.
- L. Demonstration of Complete Electrical Systems:
1. 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 Engineer is satisfied that the work has been completed in accordance with the intent of the Contract Documents.
 2. Refer to Section 16950 for additional requirements.
- M. Identification:
1. All distribution equipment (switchboards, motor control centers, distribution panelboards, transformers, transfer switches, disconnects, starters, control panels, control stations, etc.) shall have an engraved lamacoid tag, permanently mounted adjacent to the manufacturer's nameplate, indicating the equipment's designation (as called out on the Drawings) and identification number per the Contract Documents.
 2. All switchboard and distribution panel overcurrent devices, motor control center devices, individually mounted motor controllers, disconnect switches, control devices, etc., shall be provided with permanently attached engraved lamacoid tags indicating the equipment which they serve or control per the equipment designation and identification number indicated in the Contract Documents, and in accordance with OSHA requirements.

3. All branch circuit panelboards shall have, on the inner side of the door, a permanently attached, engraved lamacoid tag with the identification number of that panelboard. Provide and mount under plastic, in the directory frame of each panelboard, a neatly typewritten directory identifying the branch circuit overcurrent devices and the circuits, devices and areas which they serve.
4. All individually mounted panelboards, disconnects, motor controllers, control stations, etc. shall have a second engraved lamacoid tag below the first one which identifies from where the equipment is receiving power. This second label shall be smaller in height.
5. Nomenclature on these nametags shall be project specific and wherever possible shall be full and complete. Excess abbreviations will not be allowed.
6. Power conductors shall be continuously polarized and color coded throughout using the following scheme:
 - a. White or gray - All neutral conductors, 208/120V systems
 - b. White w/tracer of any color but Green - All neutral conductors, 480/277 volt systems
 - c. Green - All ground conductors
 - d. Phase Conductors

<u>208/120V</u> <u>Systems</u>	<u>240/120V</u> <u>Systems</u>	<u>480/277V</u> <u>Systems</u>
Phase A - Black	Phase A - Black/(Red)	Phase A - Yellow
Phase B - Red	Phase B - Red/(Blue)	Phase B - Brown
Phase C - Blue		Phase C - Orange

- e. 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.
7. Control conductors shall be identified using numerical tags corresponding to conductor designations indicated on approved shop drawings of schematic diagrams, and as required for clarification of system and equipment connections. Conductors shall be clearly identified at each terminal block, equipment connection and junction. Tags and labels shall be pre-manufactured for intended purpose.
8. Lamacoid tags shall be nominal 1" x 4" with 3/8" white lettering on black background.
9. The following safety signage shall be provided for the following equipment. Signage shall be lamacoid plastic (Large Letters) yellow background with red engraved letters:
 - a. All switchboards, motor control centers, VFD equipment, automatic transfer switches, solid-state, reduced-voltage starters, enclosed circuit breakers, etc., shall be provided with signage to read "DANGER - HIGH VOLTAGE". Each section (vertical component of multi-section

- enclosure) shall be furnished with an individual signage. Final requirements shall be determined at the discretion of the Engineer.
- b. All motor control center motors starters, individual motor starters and/or control panels shall be provided with signage to read "CAUTION - This Enclosure Contains Voltage Sources from Outside of This Enclosure".
 - c. All switchboards, motor control centers, panel boards, transformers control panels, etc., shall have large letter lamacoid nameplates which reflect the full tag names and designations noted on the Contract Drawings.
 - d. All switchboards, motor control centers, panel boards, transformers control panels, etc., shall have Arc Flash labels as provided and determined by the Arc Flash Study.
10. Label and identify with branch circuit and lighting panel for all light switches, manual motor starters, and receptacles.
- N. All electrical equipment shall be suitable for the areas where mounted in accordance with Area Classifications indicated on Electrical Drawings. In specific, refer to Drawing E-1 NEMA classification for Electrical Equipment and Enclosures for specific requirements and these specifications. In addition, there are several areas which have been indicated to meet NEC National Electrical Code requirements based on the final location of the equipment. Coordinate and provide these NEMA ratings whether or not specifically stated on the Drawings. Contractor shall assure that the proper type, enclosure, mounting and catalog numbers are provided during the Submittal phase.

1.2 QUALITY ASSURANCE

- A. Supply all new materials, devices and equipment in conformance with:
 - 1. Underwriter's Laboratory, Inc.
 - 2. National Electrical Manufacturers Association.
 - 3. American National Standards Institute.
 - 4. National Electrical Code (NEC).
 - 5. Local Power Company.
 - 6. Local Telephone Company
 - 7. Local Internet Provider
 - 8. OSHA
- B. All materials provided under this Contract shall be equal in quality, appearance and performance to that specified herein and shall be subject to no exceptions taken by 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 review. The discontinuance of production of any material or product after the Engineer's review has been made shall not relieve the Contractor from furnishing an alternate of equal quality and design without additional cost.
- C. 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.
- D. 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. For a period of twelve (12) months from the date of acceptance of the work, provide 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.

- E. All switchboards, motor control centers, panelboards, motor starters, transformers, and distribution equipment shall be by the same manufacturer based on providing the Owner with equipment of the same type. This will allow for replacement and spare parts of the same type and also allow efficient maintenance of this equipment.
- F. All electrical equipment shall be suitable for the areas where mounted in accordance with Area Classifications indicated on Electrical Drawing E-1. Contractor shall assure all equipment is installed in strict accordance with the latest version of the National Electrical Code.
- G. All equipment to be submitted such as low voltage switchboards, motor control centers, panelboards, dry-type transformers, motor starters, disconnect switches, etc. shall be furnished by the same single manufacturer unless otherwise noted. Substitutions of multiple manufacturers for this equipment shall be rejected.

1.3 SEISMIC CONTROL

- A. Refer to DIVISION 13 - Seismic Restraint Requirements for Nonstructural Components for electrical system seismic requirements.

1.4 SUBSTITUTIONS

- A. General
 - 1. Where new equipment is specified to be provided as part of an extension to an existing system, the manufacturer of the new equipment shall match that of the original. Substitutions will not be considered as equal unless specifically noted so.
 - 2. Certain new equipment and systems have been specified with one or more make(s) followed by the phrase "or equal". In such cases, the Contractor may submit a proposed substitution for review by the Engineer. The decision of equality of a proposed substitution rests fully with the Engineer.
 - 3. Certain new equipment and systems have been specified with one or more make(s) WITHOUT the phrase "or equal". In such cases, only one of the manufactured products listed will be allowed. No other manufacturer is allowed.
 - 4. Where substitutions are allowed as "equal" it shall be the Contractor's responsibility to make any and all necessary modifications required to accommodate the installation of the substituted item(s) at no additional cost to the Owner.
 - 5. The Drawings have been designed and shown with a basis of design being of a specific vendor. This Contractor shall understand that if the submission is by another vendor to be considered as an equal then it shall be his/her responsibility to provide a system which will be thoroughly coordinated to meet the intended design. Any additional equipment, conduit, wiring, controls, etc., required to

make the final installation "as equal" will be the responsibility of the Contractor and shall be included at no cost to the Owner.

6. Systems submitted which require extensive work in order to review will be rejected or the Contractor shall be assessed additional costs for additional resubmissions required for obtaining no exceptions by the engineer for the equipment to be considered as an acceptable equal submission.

1.5 SHOP DRAWINGS

A. General:

1. Submit Shop Drawings in accordance with General Conditions and as indicated herein.
2. Shop Drawings shall be submitted on all items of equipment and systems as indicated in related sections of DIVISION 16.
3. Shop Drawings submitted by equipment vendors shall be thoroughly checked by the Contractor for compliance and completeness with the Contract Documents prior to being submitted to the Engineer for review as follows:
 - a. Verify that all equipment and materials proposed to be furnished will fit into the available space.
 - b. All required or specified clearances are maintained
 - c. All equipment is compatible with the general building construction of the areas into which they are to be installed.
4. The submittal of any Shop Drawing implies that the Contractor has reviewed this Shop Drawing and that the above requirements have been met.
5. Shop Drawings submitted shall be complete and in its entirety in one bound notebook as required by Specification 01340. For example, Specification 16050 Basic Materials shall include all items in this specification which will be required for this project. Except in special instances, previously agreed to by the Engineer, partial submittals will not be reviewed or accepted.

B. Shop Drawings:

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. These cut sheets shall be marked up to indicate equipment, sizes, types, etc., of equipment and all options being provided.
 - e. Equipment ratings, service clearances and configuration.
 - f. Listing of accessories to be furnished.
 - g. Single-line and schematic diagrams where applicable. All text and symbols shall be easily legible and submitted on a 11"x17" sized drawing(s) as necessary.
 - h. Refer to related sections of the specifications for special shop drawing requirements for individual equipment types.
2. All Cut Sheets shall be marked up to indicate specific equipment, specific sizes, specific types, etc., for all equipment and materials with all options provided

- for this project. Catalog cut sheets not properly marked up, or are difficult to read and understand as to what equipment or application that it is used for, will be returned un-reviewed, for re-submittal.
3. 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 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.
 - e. 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 these delays due to equipment not being approved or being rejected for these reasons shall be the responsibility of the Contractor.
 4. Provide samples of such items as lighting fixtures, conduit, and wiring devices upon request of the Engineer.
- C. The following example is provided as a suggested formatting guideline. In addition to expediting the review process, this formatting will help ensure that the vendor has included all items applicable to the submittal, reduce the number of re-submittals and ensure a quality project.
1. Submittal Formatting:
 - a. Project information as required by the contract specifications.
 - b. Contact page.
 - c. Index sheet - this sheet shall list each tab with a description of its contents, i.e., Tab 1 - MCC 12.
 - d. Each tab shall be set up as follows:
 - i. Pertinent project specific information and modifications associated with this MCC, with references to the general information tab number.
 - ii. A parts list of all items/devices and accessories associated with this MCC including starters, relays, controls, fuses, etc.
 - iii. A project specific nameplate data sheet for the MCC - this shall include, but not limited to, full project specific title descriptions, starter/feeder information and submitted wiring diagram number.
 - iv. Dimensioned MCC layout plans and elevations pertaining only to

- this MCC.
- v. Project specific MCC one line diagram.
 - vi. A complete set of project specific wiring diagrams for all loads associated with this MCC. Wiring diagrams shall include the following general information: The full project specific title of the load served and the submitted applicable compartment number. If more than one motor of a specific load within the applicable MCC is indicated then separate and identified wiring diagrams shall be submitted for each load description and compartment number. All wiring diagram information and notation shall be clearly defined and referenced. Common wiring diagrams will not be acceptable.
2. As shown, this format is set up for a motor control center submittal, however, the same format shall be used for all switchboards, control panels, lighting panels etc.
 3. Each submittal shall be neatly bound with typewritten index sheets.
 4. Each control panel, system or equipment package shall be submitted in its entirety with all associated controls, devices, panels, layouts, wiring diagrams etc., included.
 5. If the contractor relies on the equipment provider to submit this information, it shall be the Contractor's responsibility to ensure the format is as noted above. Submittals which do not clearly indicate, in an organized manner, what is being provided will be rejected, without being reviewed, for the submittal.
 6. Equipment submitted which will be used throughout the facility, such as Local Control Stations, junction boxes, conduit, panels etc., shall clearly indicate which areas these will be located or used for, either on the submittal or a cross referenced list i.e., PVC conduit - Chemical Room, or screw type covered stainless steel enclosure - pullbox in NEMA 4X environments, etc.

1.6 SUBMITTALS TO THE ENGINEER

- A. Provide all certificates of inspection and approval from all regulatory agencies having jurisdiction over the Work under Division 16.
- B. Maintain properly documented and witnessed test and checkout reports and submit these to the Engineer prior to energizing the Electrical system.
- 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 in one final, complete submittal. These directions shall be neatly bound, consist of typewritten on 8-1/2" x 11" sheets with index tabs, and shall be accompanied by plans, diagrams, etc. of the work installed, parts lists, warranties, test reports, etc. necessary for the guidance of the Owner in operating, altering or repairing the installation. In addition to the foregoing, furnish the Engineer a written statement from the Owner indicating that he is 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.

1.7 O&M REQUIREMENTS

- A. 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 typewritten 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 he is satisfied with the operating instructions given.
- B. 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.
- C. At the completion of the installation, provide six copies of reproducible Record Drawings on sheets no less than 11"x17", indicating the final configuration of all systems as they were installed. Symbols, equipment designations, etc., shall be consistent with the Contract Documents. The following diagrams shall be included:
 1. Panel diagrams on 11"x17" 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, etc.
 3. All drawing will be provided to the Owner as record drawings in either Autocad DWG format or Adobe PDF format.
- D. All pages shall be marked up indicating only relevant information pertaining to the project and non-relevant information shall be crossed out.
- E. Provide a section for the following sections for each equipment as applicable:
 1. A description of operation
 2. Installation
 3. Emergency Operation Procedures
 4. A troubleshoot guide with common failures and possible causes
 5. A preventative maintenance schedule
 6. List of recommended spare parts.

1.8 RECORD DRAWINGS

- A. At the completion of the installation, provide reproducible Record Drawings indicating the final configuration of all Electrical 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.
- B. Contractor shall provide detailed instrumentation loop diagrams, control panel diagrams, and motor schematics indicating exact point to point wiring. The electrical contractor and instrumentation vendor shall prepare the diagrams jointly to allow full coordination.
- C. During construction a clean set of red lined drawings will be set aside in the construction trailer with markups of changes which occur during the construction of

the project. These are required and will be inspected for making sure that the contractor is recording these field changes for implantation to final record drawing submittals. Upon completion of the project these red lined drawings will be used to generate field as-built final drawings by the contractor. A copy will be provided to the Engineer for record proposal.

- D. As-Built copies of all shop drawings shall be submitted to the Engineer along with the As-Built drawings prior to final acceptance of the project.

1.9 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. Exercise care during loading, transporting, unloading and handling of materials to prevent damage.
- C. Check for defective or damaged materials, and for incomplete equipment shipments within seven (7) days after equipment delivery to the project site.
- D. Store materials and equipment on the construction site in enclosures or under protective covering and off the ground in order to keep materials and equipment undamaged, clean, and dry.
- E. 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.

1.10 GUARANTEE/WARRANTY

- A. Guarantee all equipment, materials and workmanship in accordance with the General Conditions and Supplemental Conditions of the Construction Contract and Section 11000.
- B. Warrant all material furnished and work executed is in accordance with all applicable laws and regulations.

1.11 SUBCONTRACTOR COORDINATION AND RESPONSIBILITY

- A. Coordination with Division 13
 - 1. Instrumentation supplier shall provide point to point wiring schematics to electrical subcontractor to allow completion of all instrumentation and control conduit and wiring between all devices, system control panels, and all equipment provided by instrumentation supplier and equipment provided by electrical subcontractor.
 - 2. The instrumentation supplier shall coordinate all power, control and signal needs or requirements with the electrical contractor prior to construction.
- B. Coordination with Division 15
- C. Electrical subcontractor is responsible to review the HVAC Drawings and Specifications to determine the power conduit and wiring requirements. Electrical subcontractor is responsible to implement conduit and wiring needs to match the functional descriptions in DIV. 15 except that specifically identified as being provided by the HVAC subcontractor. HVAC subcontractor shall be responsible for all control, low voltage 24VDC / 24VAC, conduit and wiring. This shall include,

but is not necessarily limited to, wiring for automatic temperature control, and control wiring for plumbing systems. The HVAC subcontractor shall provide all miscellaneous 120VAC control from HVAC control panels to final control devices, as required, unless specifically included in Electrical work per the Drawings and Specifications. Coordination with Division 2 and Division 3.

1. The electrical subcontractor is required to provide a substantial amount of underground work and coordination relating to the following items:
 - a. Underground duct banks and installation
 - b. Standby Generator
 - c. Existing and new underground utilities and process equipment
 - i. Excavation, bedding and backfilling: The electrical subcontractor shall coordinate all excavation for duct bank locations for both new and existing conditions with this section in order to provide a complete understanding of where and how these duct banks are to be installed.
 - ii. Duct banks shall be formed up neat and tight to provide for proper encasement of conduits. Reinforcing steel shall also be furnished and installed.
 - iii. Coordinate pad sizing, openings and orientation with selected equipment for proper installation.
- D. Coordination with Miscellaneous Divisions
 1. The electrical contractor shall coordinate all coring, cutting and patching of openings in all structures and locations with the General Contractor in a timely manner not to delay scheduling of the project.
- E. Schedules:
 1. The electrical subcontractor shall maintain close contact and coordination at all times with the work of these related Divisions in order to provide a complete electrical system or delay the scheduling of the project.
 2. Perform all coordination and scheduling of all cutting, temporary power usage with all other trades. patching, trenching, painting, trench covers, plastering, chases, slots, furring, grounds, masonry foundations, piers, excavating, bases, backfilling, pads, duct banks and other work incidental to installation of apparatus as required for electrical work.

1.12 CONDUIT LAYOUT PLANS AND DETAILS FOR CONCEALED AND EXPOSED WORK

- A. The Contract documents require that conduit be concealed in walls, floors, ceilings or below floor slab in slab on grade areas due to the configuration and layout of the proposed building construction.
- B. In areas of exposed conduits, conduits shall be installed via vertical drops down to equipment in order to maintain a clean and consistent look of conduit for this installation. Horizontal runs shall be limited to ceiling racked installation and shall drop down to equipment. In areas of hung ceilings and accessible space above ceilings conduits shall be installed concealed within these areas with vertical drop down to the equipment to be fed.
- C. A detailed conduit layout plan and routing path for the new work shall be submitted for review and with no exceptions taken by the engineer prior to performing any

- work. The plan shall clearly indicate the equipment locations and path of runs along with overall sizes of conduits to be installed for a complete layout plan.
- D. The contract drawings specifically note areas with block-out structural openings for the installation of conduits into and within the proposed building. A coordination review of equipment locations and layouts will be required such that the conduit layout plan has been pre-planned and approved prior to the commencing of the work. There is a significant amount of conduit to be installed under this project and this plan will provide an overview of the intended work to be pre-formed.
 - E. The contractor shall be allowed to reduce the number of conduit runs by combining conduit runs and increasing overall conduit sizes based on the National Electrical Code (NEC) allowable sizing and derating requirements. The contract documents will limit this however based on the allowable sizing of conduits both underground and within the slab and also this will be limited to smaller branch circuit feeders. Individual motor feeders to equipment such as pumps, process equipment runs, electrical distribution feeders and HVAC larger loads will not be allowed to be combined as further stated within the contract documents.
 - F. The Conduit and Wire Schedule has provided a summary of individual conduit runs throughout the project in order to clearly indicate where conduit and wiring is to be installed. The contractor shall utilize the schedule along with the electrical plans to develop the overall Conduit Layout Plans as required under this section. The submitted plans shall be formatted on 2' x 3' full size plans and submitted as part of the shop drawings requirements for this project prior to commencing any and all work. The Conduit Layout Plans shall also provide all equipment locations, sizing and identification.
 - G. The electrical contract drawings are diagrammatic and may not specifically show exact locations of the equipment. The contractor shall coordinate all conduit layout, and dimensions with the final equipment locations for the entire project for both concealed and exposed conduit runs.

1.13 BID ALLOWANCE AND COST TO BE CARRIED UNDER THIS CONTRACT

- A. The Electrical Subcontractor shall include as part of his/her overall bid an allowance for all work to be performed by the respective utility companies or service companies under this Contract. Refer to the requirements listed under the bid items of the General Conditions.
- B. Electric Utility Company direct charges for their own work associated with the required modifications and extension of the existing overhead and underground distribution lines to the new facility, as well as providing new utility-owned service equipment and transformer, shall be paid for under this bid allowance. All other required work associated with the new Electrical Service to the facility shall be included in the Base Bid under this contract.
- C. The Electrical Subcontractor shall include as part of his/her overall bid an allowance for all required work and charges by the Telephone Company for telephone services, for installation of work in order to provide the required services for tie-ins of the telemetry and alarm system for this project. Coordinate all work necessary for the telephone service as required under the work of this contract.
- D. The Bid Allowance shall include only work and costs to be paid for work to be performed by the respective utility companies or service companies. All work

required by the Electrical Subcontractor shall be included in the Base Bid and not part of this allowance. Refer to Measurement and Payment Section 01150 and Section 00310 of this specification for additional requirements. An allowance amount has been identified and included in the bid items for the work to be performed by the respective utility companies. This amount is to be included as part of the overall costs for the work of Division 16. Refer to bid items for summary of these costs.

1.14 WORK ASSOCIATED WITH UTILITY COMPANIES AND SERVICE COMPANIES

- A. The Power Company serving this project is Eversouce.
1. The Power Company contact information is as follows:
Contact Person: Jim King
Contact Telephone No: 860-267-3879
 2. The existing electrical service account number is 5109 689 2021.
 3. The new electrical service work order number is 3165040.
 4. Coordinate all work required by the Power Company via the contact referenced above and contact this individual concerning any questions regarding this work.
 5. The work of the Power Company is shown on the Contract Drawings. The following is a summary of this work:
 - a. Install temporary electric service to the project location necessary for the sequence of construction.
 - b. Remove existing primary service including all required demolitions and removals including the existing service riser pole, transformer, etc. for a complete demolition.
 - c. Modify overhead primary service for permanent electric service.
 - d. Install new primary and secondary electric services, new service riser pole, service transformer, etc. and metering and work required by them for the new permanent electric service.
 - e. Coordinate all required shutdowns and energizations for the existing and new electrical services for both primary and secondary system requirements for a completely new electrical system installation.
 - f. All other associated work required by them for the needs of this project.
- B. The Telephone Company serving this project is AT & T.
1. The Telephone Company Engineering Service Center shall be the contact point for this work.
Contact Person: David Cascio, Account Manager.
Contact Telephone No: 203-287-4427.
 2. Coordinate all work required by the Telephone Company for the project.
 3. The work of the Telephone Company is shown on the Contract Drawings. The following is a summary of this work:
 - a. Install temporary telephone (telemetry) service to the project locations necessary for the sequence of construction.
 - b. Remove existing underground telephone service as indicated on the drawings and all associated telephone interface equipment for a complete demolition.
 - c. Modify overhead telephone service for permanent telephone service.

- d. Install new underground telephone cables and telephone interface equipment required by them for the new permanent telephone service.
- e. All other associated work required by them for the needs of this project.

1.15 TEMPORARY POWER, TELEPHONE, AND TELEMETRY REQUIREMENTS

- A. It shall be required that the Electrical Sub-contractor maintain the existing facility and associated equipment operational during all times of the work of this contract. This Contractor shall be responsible to provide temporary power (both normal and emergency standby power) to energize and maintain system operations.
- B. This shall include all power, control, signal, telephone and telemetry system requirements. There will be a need to provide temporary telephone services to the facility in order to meet the operational requirements of the facility equipment. This shall be based on the sequence of construction required for this project.
- C. Temporary light & power.
 - 1. The Electrical Contractor shall provide all temporary power, and the General Contractor shall pay for all temporary power usage fees typically, the electrical subcontractor will provide the temporary electrical services and exclude energy usage fees. the general contractor or the owner will typically pay for the energy usage fees associated with the project.
 - 2. Limit temporary service to 100 amperes, 120/240 volt, 1 phase, 3 wire.
 - 3. Limit power and hand tool usage to motors not exceeding 1/2 HP.
 - 4. Temporary power shall be separate from process power required to maintain the existing facility operational during sequence of construction and the duration of the project.

1.16 MEASUREMENT AND PAYMENT

- A. Measurement and payment for the work described in this section will be made in accordance with the provisions of DIVISION 1 MEASUREMENT AND PAYMENT.

1.17 REQUEST FOR INFORMATION

- A. 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 as required for this contract. This process shall be used as part of the work of this contract.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials shall be as specified in the appropriate Sections of DIVISION 16.
- B. No exceptions to the Engineer of materials shall be as indicated in these Sections.

PART 3 - INSTALLATION

3.1 INSTALLATION

- A. Installation shall be as specified in the appropriate Sections of DIVISION 16.

3.2 TESTS

- A. Refer to all related requirements as set forth within SECTION 16950 and additional testing as indicated in the appropriate Sections of DIVISION 16.

3.3 CLEANING

- A. Do not allow refuse and surplus materials to accumulate on the project site during the course of the work. Areas shall be cleaned and picked up on a daily basis.
- B. Upon completion of the work, remove all refuse and surplus materials and leave the premises neat and clean on a daily basis.
- C. Clean all equipment surfaces and touch up all damaged surfaces to the satisfaction of the Engineer.
- D. Clean all lighting fixture reflector assemblies, lenses, louvers and lamps upon completion of the installation.

END OF SECTION

SECTION 16050

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Drawings are diagrammatic, unless detailed dimensioned Drawings are included, and show approximate locations of distribution equipment, fixtures, control panels and wiring devices. Equipment layouts shall be submitted prior to work in these areas with sufficient time for a detailed review. All equipment and locations shall be closely reviewed and coordinated. Coordinate all work and equipment locations with the Engineer prior to performing final installations.
- B. While the general run of electrical feeders, branch circuits and conduits are indicated on the Drawings, it is not intended that exact routing be determined there from. Conductors can be combined in conduits for ease of construction as permitted by these specifications and the latest edition of the N.E.C.
- C. Circuit designations can be found on the contract drawings in the combination of any of the following formats:

Single Line Diagrams	"Home Runs"
Electrical Schematics	Wiring Diagrams
Control and Instrumentation Diagrams	Panelboard Schedules Conduit and Wire Schedule

The Contractor shall be responsible for reviewing all drawings and may modify these designations subject to field conditions and review of the Engineer.

- D. Measurements shall be made and coordinated with all approved equipment at the site and in the buildings during construction and all systems installed as the work progresses in such a manner that the equipment, piping, vents, ducts, conduit, etc., will fit in the space provided, maintain head room and if in unfinished areas, be as neatly installed, as obscure and "out-of-the- way" as physically possible.
- E. Prior to submission for review any item of equipment, determine whether or not it will fit in the space provided and that no design changes in conduits, wiring or controls will be required. Any changes in the size, location or interconnections of the material or equipment supplied, which may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of the Engineer and no exceptions must be taken before such alterations are made.
- F. All equipment and accessories and its interconnecting piping, ductwork, conduits, etc., shall be installed in such a manner that ample maintenance passage and Code-required space/access will be provided.
- G. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. In general ductwork shall be given preference (except where grading of piping becomes a problem) followed by piping then electrical

wiring. If, after installation of any equipment, piping, ducts, conduit, etc., it is determined that ample maintenance and passage space has not been provided, the work shall be rearranged and/or furnished with other equipment as required to provide this space at no additional cost to the Engineer. The Contractor shall review the drawings for all other trades to determine any potential interferences and identify and coordinate with those with other trades.

- H. 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 for 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 shall be provided in an appropriate time period. RFI form shall be available via the General Contractor through the Engineer as required for this contract. This process shall be used as part of the work of 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 approval of the Engineer.
- B. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of 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. All efforts shall be made in the location and installations of all raceways and equipment for a neat, logical, and safe installation as it pertains to personnel and operations.
- E. All electrical conduits and associated electrical devices, etc., shall be installed concealed wherever possible in order to provide for a clean and limited amount of exposed conduit runs. Coordinate all work with the Engineer prior to performing this work. Where hung ceiling and upper attic space exists for the project areas conduit and boxes shall be installed in the above attic spaces with only vertical drops down to the equipment. Horizontal conduit runs shall be limited to short, clean installations.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submittals shall be provided in accordance with Sections 01340, 16010 and as specified in this section.
- B. The contractor shall be responsible to submit a complete list of conduit type to be used for all locations of the project. A Conduit Layout Plan shall be submitted as a shop drawing with the following:
 - 1. Shall include a column for exposed and concealed conduit heading. Mark up each location with the type of conduit to be used for the respective space in the appropriate heading of exposed and concealed installation.
 - 2. Provide detailed drawings indicating intended routing and combination of conductors. Refer to section 16010 for additional requirements.

- C. Submit a shop drawing for the following equipment, materials, products, etc.:
1. Conduit, Raceway and Tubing.
 2. Conductors and Cable
 3. Outlet Boxes
 4. Pull and Junction Boxes and Terminal Cabinets
 5. Wiring Devices
 6. Control Devices and Equipment
 7. Motor Starters
 8. Safety Disconnect Switches
 9. Enclosed Circuit Breakers
 10. Fuses
 11. Ground Rods
 12. Metal Framing Channel
 13. Phase Failure Relays
 14. Time Delay Relays (Electro-pneumatic)
 15. Submission of written verification that the electrical manholes, handholes and covers, electrical duct banks and transformer pads have been coordinated, reviewed and acceptable with the electrical work to be provided under this Section.
 16. Distribution Equipment
 17. Motor Control Centers
 18. Main Switchboard and Secondary Switchboards
 19. Control Panels
 20. Miscellaneous Electrical Distribution Equipment
 21. Lighting Fixtures
 22. Variable frequency drives
 23. Transformers
 24. Lighting flexible hangers
 25. Conduit and wall and floor link seal fittings
 26. Conduit cable sealing fittings
 27. Test results on all feeder conductors and heat trace cables as specified in Section 19050.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Conduit, Raceway and Tubing
1. Rigid Heavy Wall Steel Conduit (RSC or RGS) shall be constructed of hot dipped galvanized or electro-galvanized steel. Acceptable Manufacturers: Allied - a division of Atkore, Wheatland, Republic Conduit, or equal.
 2. 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 - a division of Atkore, Wheatland, Republic Conduit, or equal.
 3. Aluminum conduit shall be rigid, heavy wall aluminum. Acceptable manufacturers: Anaconda, Kaiser, VAW, or equal.

4. Flexible Metal Conduit
 - a. 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.
 - b. Flexible metal conduit shall be "liquid-tight" with PVC jacket. Acceptable Manufacturers: Alflex - a division of Southwire, Electri-Flex, Thomas & Betts - a division of ABB, or equal.
 - c. 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.
5. Non-Metallic (P.V.C.) Conduit shall be Schedule 80, extra heavy wall or Schedule 40, heavy wall and UL Listed for the use intended. Acceptable Manufacturers: Carlon, Harrison, JM Eagle, or equal.
6. P.V.C. Coated Rigid Galvanized Steel Conduit
 - a. The PVC Coated Rigid Galvanized Steel conduit, shall fully comply with the following industry listings and manufacturer's standards without exception prior to PVC coated application, shall conform to Federal Specifications WW-C-581E, ANSI Standard C80.1, ANSI Standard C80.5 UL Standard #6 and NEMA RN1-2005.
 - b. The PVC coated rigid galvanized steel (RGS) conduit shall comply with the below listed specifications without exceptions allowed. PVC coated rigid galvanized steel (RGS) conduit shall be hot dipped galvanized both internally & externally. The PVC coated rigid galvanized (RGS) conduit shall have hot dipped galvanized threads. The external PVC coating shall be a nominal 40 mils of external PVC coating and 2 mils of blue interior urethane coating. The PVC coating shall be applied by the same manufacturer of the hot dipped galvanized rigid steel (RGS) conduit.
 - c. Conduit bodies and fittings for PVC coated rigid galvanized steel (RGS) conduit shall be from the same manufacturer as the PVC coated rigid galvanized steel (RGS) conduit. Conduit bodies shall be coated on the entire body both internally and externally with 2 mil of blue urethane and exterior coated with 40mil of PVC coating.
 - d. All conduit, conduit bodies, connectors, support systems and accessories in the corrosive areas, above grade or below grade, shall be coated as specified.
 - e. The thickness of the coating is to be a nominal 40 mils except where the configuration or application of the unit dictates otherwise.
 - f. PVC coated conduit shall be UL or ETL Listed.
 - g. During the manufacturing of the PVC coated rigid galvanized steel (RGS) conduit, the factory applied hot dipped galvanized coating of both the internal and external (RGS) conduit shall not be disturbed in any fashion prior to the application of PVC coating being applied as per UL 6. The

PVC coated rigid galvanized steel (RGS) conduit shall comply with all UL listings providing the hot dipped galvanized coating as the primary means of protection of corrosion protection for the conduit, and the PVC coating shall be listed as a secondary means of corrosion protection as required by UL 6 and NEMA RN-1-2005.

- h. Every female opening shall have a plastic sleeve extending one pipe diameter or 2", whichever is less, beyond the opening. The inside diameter of the sleeve shall be the same as the outside diameter of the pipe used with it. The wall thickness of the sleeve shall be the same as the plastic coating.
 - i. Fittings and Accessories:
 - i. Right angle beam clamps and U-bolts will be provided with PVC encapsulated nuts that cover all exposed parts of the threads.
 - ii. U-bolts will be sized to snugly fit the nominal 40 mil coated conduit.
 - iii. The screw heads on Form 8 condulets shall be stainless steel encapsulated by the same manufacturer. All conduit bodies used in wash down, wet or outdoor applications shall be NEMA 4X rated.
 - iv. Couplings shall have longitudinal ribs 40 mils in thickness to protect them from wrenches or channel-locks.
 - v. All coated conduit and fittings must be installed wherever possible by a certified trained installer using a tool available from the manufacturer for the use intended in order to protect the PVC coating.
 - j. The interior coating shall be applied in such a manner so as to allow field bending without cracking or flaking of the interior coating.
 - k. All fittings shall be of the same material as the respective raceway system.
7. Acceptable manufacturers shall be: Plasti-Bond, Thomas & Betts-a Division of ABB/Ocal, Perma-COTE, or equal.

B. Conductors and Cable

- 1. All power wiring conductors (P-X on drawings) shall be insulated for 600 volts, Type XHHW insulation, unless otherwise noted. Conductors shall be standard AWG and KCMIL sizes. Conductors shall be 98 percent copper, stranded, heat and moisture resistant with cross-linked synthetic polymer insulation for all sizes No. 12 AWG and larger. Smaller sizes shall not be used except for communications and special systems. For lighting and receptacle circuits, solid wire may be used in lieu of stranded wire, for No. 12 and No. 10 AWG only. Conductors shall be labeled with U.L. approval and be marked with the manufacturer's name, wire size and insulation type. All underground power cables shall be UL Listed and Labeled for underground use in wet locations. Acceptable Manufacturers: Okonite, Southwire, Pirelli, or equal.
- 2. Variable frequency drive (VFD) motor supply 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. All underground power

- cables shall be U.L. Listed and Labeled for underground use in wet locations. Acceptable Manufacturers: Belden, Olflex, Houston Wire & Cable, or equal.
3. Control Wiring:
 - a. All control wiring (120 or 24 volt, AC or DC) conductors within buildings or above grade shall be insulated for 600 volts, unless otherwise noted, and shall be No. 14 AWG minimum size, or larger if so indicated on the Drawings. Conductors shall be 98 percent copper, stranded, heat and moisture resistant, and thermal plastic insulated and shall be type THWN/THHN.
 - b. All conductors for control wiring located below grade shall be 600V, 98 percent copper, stranded, heat and moisture resistant, with cross-linked synthetic polymer insulation type XHHW. All underground control cables shall be U.L. Listed and Labeled for underground use in wet locations. Acceptable Manufacturers: Okonite, Southwire, Pirelli, or equal.
 4. Metal clad cable shall consist of thermal plastic insulated copper conductors, of size and quantity indicated, protected by a positive interlocked armor of galvanized steel. The conductors shall be twisted together and shall have an overall moisture and fire resistant fibrous covering. The cable shall have a grounding conductor of copper. The cable shall meet the requirements of Article 330 of the National Electrical Code for "Type MC" Metal Clad Cable and shall bear the U. L. Label. Acceptable Manufacturers: Okonite, Pirelli, Houston Wire & Cable, or equal.
 5. Tray cable shall consist of 600V copper conductors, of size and quantity as indicated on the Drawings, protected by a positive PVC outer plastic abrasion resistant fire resistant covering. The conductors shall be twisted together and shall have an overall moisture and fire resistant fibrous covering. The cable shall have a grounding conductor of copper. The cable shall meet the requirements of Article 336 of the National Electrical Code for "Type TC" Tray Cable and shall bear the U. L. Label. Acceptable Manufacturers: U.S. Wire & Cable, Houston Wire & Cable, or equal.
 6. All instrumentation control cables (4-20 mA signal) referred to on the Drawings as "twisted shielded pairs", shall be rated 600V, 80 deg. C, individually shielded twisted pairs, No. 16 AWG, stranded conductors of tinned copper with polyethylene insulation and aluminum-polyester shielding with #18 awg stranded copper drain wire surrounded by a chrome PVC jacket. Control cable shall be UL listed with 100% shield coverage. All underground instrumentation cables shall be U.L. Listed and Labeled for underground use in wet locations. Acceptable Manufacturers: Belden, Alpha Wire & Cable or equal. Provide instrumentation control cables equivalent to Belden type 8719 or equivalent unless specified otherwise by the instrument manufacturer.
 7. Data Wiring:
 - a. Cables for data wiring shall be Category 6, 4-pair, 24 AWG solid bare copper conductor, unshielded, FEP insulation, plenum rated. Acceptable Manufacturers: Belden Type 7813LC, Alpha Wire & Cable, or equal.
 8. Fire Alarm Wiring:

- a. Signaling circuit conductors for fire alarm wiring installed within buildings shall be 300V, 105 deg C, power limited, type FPLR cable, #14 AWG minimum solid bare copper with PVC insulation encased in a red PVC outer jacket. Acceptable Manufacturers: Belden type 9580 (for two conductors), Alpha Wire & Cable, Houston Wire, or equal. See drawings for exact number of conductors.
 - b. Fire alarm wiring installed within buildings indicated on the drawings to be shielded shall be 300V, 105 deg C, power limited, type FPLR cable, #14 AWG minimum solid bare copper with PVC insulation, aluminum-polyester shield and a #16 awg stranded tinned copper drain wire encased in a red PVC outer jacket. Acceptable Manufacturers: Belden, Alpha Wire & Cable, Houston Wire, or equal. Provide fire alarm wiring equivalent to Belden type 9581 (for two conductors). See drawings for exact number of conductors.
9. Telephone wiring:
- a. Conductors for telephone wiring in indoor applications shall be 150 V, 80 degrees C, tinned copper, PVC insulated twisted pair, 24 gauge solid conductor with chrome PVC jacket, two-pair minimum or as indicated on the drawings, Belden type 9562, Alpha Wire and Cable or equal.
10. Fiber Optic Cable:
- a. Provide indoor/outdoor type fiber optic cable with a minimum bending radius of 4 inches and a minimum tensile strength of 300 lb.
 - b. Transmission Distance: up to 2000 km
 - c. Construction: The cable shall be loose tube type design with an inner PVC tube containing the optical fibers and an outer UV resistant, flame retardant Poly jacket.
 - d. Cables shall be outdoor/indoor rated and suitable for installation in buried conduit.
 - e. Optical Fibers: A minimum of three (3) channel (six fibers) multimode, 62.5/125 fibers per cable compatible with IEEE 802.3 10/100 Base F standard.
 - f. Termination: SC connector type to be used on all Fiber connections. Field terminations shall be fused using a splicing device specifically designed for joining fiber optic cable. Chemical fusing shall not be acceptable. The dB loss of each fiber segment shall be tested and a report shall be submitted to the Engineer of the testing results.
 - g. Fiber Optic Cable Equivalent to:
 - i. Berk-Tek Advetum
 - ii. Corning Fiber Optic Freedom Cable
 - iii. Hitachi Cable
 - iv. Or equal
11. All specified cables which are also to be used or extended underground must be UL Listed and Labeled for underground use in wet locations.

C. Outlet Boxes

1. Standard, recessed outlet boxes and covers shall be galvanized steel not less than 1-1/2 inches deep, 4 inches square or octagonal, with knockouts. Recessed boxes shall only be used for recessed work. Acceptable Manufacturers: Thomas & Betts, Steel City, OZ Gedney, Raco or equal.
2. Outlet boxes exposed to moisture or used for exposed work shall be cadmium cast alloy complete with hubs and gasketed screw fastened covers.
3. Outlet boxes used in hazardous, Class I, Div 1, Group C & D locations shall be UL Listed Feraloy iron alloy body with electrogalvanized and aluminum acrylic paint or epoxy powder coat complete with hubs as required for the installation. Provide covers to fit the application. Covers to be utilized for pendant mounted light fixtures shall incorporate flexible cushion or ball type fixture hangers rated for the area in which it is to be installed. Acceptable manufacturers: Crouse-Hinds, Appleton, or equal.
4. Outlet boxes used in corrosive, NEMA 4X areas, shall have a plastic P.V.C. coating as previously described in the conduit, raceway and tubing section. Acceptable manufacturer shall be Rob-Roy "Plasti-Bond", Thomas & Betts, Ocal, or equal.
5. In no case shall boxes be sized smaller than as indicated in Article 314 of the National Electrical Code for the conductor sizes installed.
6. Acceptable Manufacturers: Thomas & Betts, Steel City, OZ Gedney, Crouse-Hinds, Raco or equal.

D. Pull and Junction Boxes

1. Boxes shall be with trim for flush or surface mounting in accordance with the location to be installed. Provide screw-on type flush covers. Boxes with hinges and side clips are not acceptable. Boxes installed in damp locations shall be of watertight construction with gasketed cover and conduit hubs. Refer to the Electrical Drawing E-1 for NEMA rated areas for this project and pullbox type and use required.
2. Boxes installed in Class I, Div 1, Group C & D locations shall be constructed of copper free aluminum (body and cover), extruded aluminum hinges with stainless steel cover bolts and neoprene gasket. The box shall be UL Listed for the location and sized as required for the application. Provide NEMA 4/7 pullboxes when installed in these areas.
3. Boxes used in corrosive, NEMA 4X areas, shall have a plastic P.V.C. coating as previously described in the conduit, raceway and tubing section. Acceptable manufacturer shall be Rob-Roy "Plasti-Bond", Thomas & Betts – a division of ABB/ Ocal, Perma-COTE, or equal.
4. In no case shall boxes be sized smaller than as indicated in Article 317 of the National Electrical Code for Conduit and Conductor sizes installed.
5. Pullboxes in NEMA 4X areas shall be seamless welded 316, stainless steel with gasketed screw-on covers with no mechanical clips or hinges all around.

E. Expansion Fittings

1. Expansion fittings for exposed conduit runs shall be watertight expansion type designed to compensate for up to 8" of movement (4" in either direction). Fittings shall be U.L. listed, shall be malleable iron or ductile iron with exterior

and interior zinc plating for corrosion protection. With U.L. listed internal bonding jumper constructed of a tinned copper braid, sized to meet UL fault current test requirements and comply with bonding requirements –NEC 250-.98. Acceptable Manufacturer: Thomas Betts – a division of ABB Type XJG-TB O.Z./Gedney - a division of Emerson- Type EX, Crouse Hinds, or equal.

2. Expansion/deflection fittings for concealed conduit runs shall compensate for up to 3/4" of movement in any direction. Fittings shall be U.L. listed and be water, rain and concrete tight. Fittings shall be constructed of bronze end couplings, neoprene sleeve with stainless steel bands and an internal braided tinned copper bonding jumper and Ericson type conduit union. Acceptable manufacturer: O.Z. Gedney type a division of Emerson -DX, Thomas Betts – a division of ABB - type XD, or equal.

F. Wiring Devices

1. Wiring devices shall be specification grade as described herein. Switch handles, receptacles, etc. shall be installed in a single color. New wiring devices installed in existing facilities shall match previous installed devices. Provide device cover plates of satin finish stainless steel in finished areas and cadmium finished sheet steel in unfinished areas. Acceptable manufacturers are: Hubbell Inc., Cooper-Arrow-Hart – a division Eaton, Pass & Semour – a Division of Legrand, Thomas & Betts – a Division of ABB, or equal. Provide devices as indicated by Contract Documents.
2. Toggle Switches
 - a. 20 Ampere, 1-pole, 277 Volt: Hubbell 1221
 - b. 20 Ampere, 2-pole, 277 Volt: Hubbell 1222
 - c. 20 Ampere, 3-way, 277 Volt: Hubbell 1223
3. Receptacles
 - a. 20 Ampere, 125 Volt, Single Receptacle: Hubbell 5361
 - b. 20 Ampere, 125 Volt, Duplex Receptacle: Hubbell 5362
 - c. 20 Ampere, 125 Volt, Duplex G.F.I. Receptacle: Hubbell GF-5362
 - d. 20 Ampere, 125 Volt, Duplex, Weatherproof: Crouse Hinds WLGF-FS with GFI receptacle
 - e. 20 Ampere, 125 Volt, Duplex, Explosion proof:
 - i. Crouse Hinds ENR12201 W/(2) ENP5201 Plugs (Dead End Type)
 - ii. Crouse Hinds ENRC22201 W/(2) ENP5201 Plugs (Feed Thru Type)
 - f. Special duty style and type receptacles greater than 20 ampere shall be submitted for specific applications indicated on the drawings specific for each area and load to be connected.
4. Telephone/Intercommunication System Outlets
 - a. Provide 4" x 2" outlet box with Hubbell PJ216 telephone plate.
 - b. Provide outlet box with telephone RJ11 and data RJ45 for combination telephone / data outlet, as required. Single telephone RJ11 outlets only shall be provided as indicated on the drawings.
 - c. Telephone/intercommunication system outlets shall be Hubbell, Crouse-Hinds, or equal.

G. Control Devices and Equipment:

1. Photoelectric Control:

- a. 120 Volt, SPST, 2000 Watt: Tork Model 2101
- 2. Lighting and Control Contactors:
 - a. Contactors shall be electrically operated, electrically held and shall switch a load at 277 volts, 60 hertz and shall have the number of N.O. contacts and N.C. contacts shown on the Drawings. Minimum number of contacts shall be 5 N.O. and 1 N.C. contact.
 - b. The contactor shall be continuously rated 20 amperes per pole for all types of ballast and tungsten lighting and resistance loads, and shall not be de-rated for use on high-inrush loads. The coil should be continuously rated and encapsulated.
 - c. The contactor shall have double-break, silver-cadmium-oxide power contacts. Auxiliary arcing contacts are not acceptable. All power contacts shall be convertible from N.O. to N.C. or vice-versa. All contacts shall have clearly visible N.O. and N.C. contact-status indicators.
 - d. The contactor shall be approved per UL 508 and CSA.
 - e. The contactor shall be designed in accordance with NEMA ICS2-211B. They shall be industrial-duty rated for applications to 600 volts maximum.
 - f. The contactor shall have a NEMA Type 1 enclosure unless noted otherwise on the Drawings.
 - g. Refer to Drawings for location, wiring schematics and details.
 - h. Acceptable manufacturers: Square D, Cutler-Hammer, or equal.
 - i. Provide complete system lighting and control panel layout and wiring diagrams for review and approval.
- H. Motor Starters
 - 1. For Single Phase Motors: Fractional Horsepower Manual Motor Starter with Thermal Overload(s) and a red running indicating light unless noted otherwise:
 - a. 120 Volt Single-Pole, Surface Mounted: Square-D FG-1P
 - b. 120 Volt, Single-Pole, Surface Mounted, Explosion Proof: Square-D FR-1H
 - 2. Acceptable Manufacturers: Square-D, Cutler-Hammer, Allen-Bradley, or equal.
- I. Safety Switches
 - 1. All safety switches shall be NEMA Type HD and Underwriters Laboratories Listed.
 - 2. The handle position shall indicate whether the switch is "ON" or "OFF".
 - 3. All current carrying parts shall be plated to resist corrosion and promote cool operation. Switches shall have removable arc suppressers where necessary to permit easy access to line side lugs. Lugs shall be front, removable and UL listed for 60°C or 75°C, aluminum or copper wires.
 - 4. Provisions for padlocking the switch in the "OFF" position with at least three locks shall be provided.
 - 5. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door when the handle is in the "ON" position, and to prevent closing of the switch mechanism with the door open.
 - 6. Disconnect switches, indicated on the drawing to be used for motors controlled by variable frequency drives shall be as indicated above, except shall be 4 pole

type switches. The fourth pole shall be wired directly to the disable input, in series with the safety e-stop, in order to lock-out and immediately shutdown the drive. The auxiliary 4th pole shall open prior to any of the other three power poles and shall be designed for proper use with VFD type load circuits.

7. Enclosures
 - a. Safety switch enclosures for non-hazardous locations painted galvanized steel for NEMA 12 area and stainless steel for NEMA 4X areas.
 - b. Switches specified as NEMA 7 Class 1, Division 1 shall be furnished in cast aluminum enclosures with conduit provisions as specified. Enclosures shall be provided with a bolted cover and with sealing means for hazardous location protection. "ON" and "OFF" position identification shall be cast into the cover, not painted on or applied with an adhesive.
 - c. Switches specified as NEMA 7 (Class 1, Division 2) shall be furnished in non-metallic enclosures, NEMA 4X/IP66/Class 1, Division 2 rated with conduit provisions as specified. Enclosures shall be provided with "ON" and "OFF" position identification and lockable in the "OFF" and "ON" positions.
 8. Acceptable Manufacturers: Square-D, Cutler-Hammer, General Electric, Siemens, or equal.
- J. Fusible Disconnect Switches
1. Switches shall be horsepower rated for ac and/or dc as indicated by the plans. All fusible switches rated 100 thru 600 amperes at 240 volts and 30 thru 600 amperes at 600 volts shall have a UL approved method of field conversion from standard Class H fuse spacing to Class J fuse spacing. The switch also must accept Class R fuses and have provisions for field installation of a UL listed rejection feature to reject all fuses except Class R. The UL listed short circuit rating of the switches shall be 200,000 rms symmetrical amperes when Class R or Class J fuses are used with the appropriate rejection scheme. The UL listed short circuit rating of the switch, when equipped with Class H fuses, shall be 10,000 rms symmetrical amperes. The cost of any conversion kit and labor associated with conversion to accommodate the required fuses shall be included in the base bid. In general, U.L. Class H fuses are not to be used. Refer to the paragraph on fuses, this section on further requirements for fuses.
 2. Enclosures
 - a. Safety switch enclosures for non-hazardous locations painted galvanized steel for NEMA 12 area and stainless steel for NEMA 4X areas. Refer to Drawing E-1 for NEMA classifications.
 - b. Switches specified as NEMA 7 & 9 shall be furnished in cast aluminum enclosures with conduit provisions as specified. Enclosures shall be provided with a bolted cover and with sealing means for hazardous location protection. "ON" and "OFF" position identification shall be cast into the cover, not painted on or applied with an adhesive.
 3. Acceptable Manufacturers: Square-D, Cutler-Hammer, General Electric, Siemens, or equal.
- K. Manual Transfer Switch

1. The manual transfer switch shall meet NEMA rating where equipment is to be installed as shown on drawings. Manual transfer switch shall be heavy duty, double throw, quick-make, quick break with voltage, number of poles and ampere rating as noted on the Drawings.
 2. A manual transfer switch manufacturer shall have been regularly engaged in the production of U.L. (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. Manual transfer switch shall be as manufactured by Square D, General Electric, Cutler-Hammer or equal.
- L. Portable Generator Cable Connection Panel
1. Connections of the portable cables which feed out from the portable generator shall be from individual cables for each phase and neutral within the panel.
 2. Panel to be provided with ratings as shown on the single line diagrams.
 3. Portable generator cables shall be terminated with Camlock connectors and therefore the generator cable connection panel shall be a dead front and insulated bussed termination point for connecting these cables.
 4. Panel shall be front handle key lockable with proper signage and typed written procedures attached to the front of the panel.
 5. The installation shall be UL Listed and Labeled and shall be manufacturer built and tested for this application.
 6. Panel shall be installed within an enclosure with a drip shield.
 7. Provide a complete installation as shown and perform an on-site test with the owner's portable generator to verify proper operation. Coordinate all work with the Owner for final testing and connections. A 30 minute test period shall be observed and verified with the owner for final acceptance of this installation. Also provide a typed written and laminated procedure sheet for connection and operation of the portable generator equipment. Provide the step-by-step procedure for proper connection and operation and located and mount to manual transfer switch inside station for final acceptance. Coordinate written procedure with the Engineer.
 8. Acceptable manufacturer is Trystar to match Owners existing panels.
- M. Enclosed Circuit Breakers
1. Circuit breakers shall be molded case, thermal-magnetic type, ratings as noted, with overcenter, trip-free, toggle-type operating mechanism, quick-make, quick-break action and positive handle indication unless otherwise noted. Multiple pole breakers shall be common trip type. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole. Breakers shall be calibrated for operation, an ambient temperature of 40°C and shall be suitable for mounting and operating in any

- position. Breakers shall have removable lugs, U. L. listed for copper and aluminum conductors.
2. Breakers shall be installed in enclosures as specified in Section 16160, with NEMA ratings as indicated on the Drawings with a side handle operating mechanism which is pad-lockable in the “on” and “off” position. Breakers shall be provided with manufacturer installed neutral and ground kits and shall be U.L. listed and labeled for service entrance duty as noted on the drawings and where required by the N.E.C. Short circuit ratings of equipment shall be as noted on the drawings or shall be rated equal to the equipment or motor control center which they feed. The minimum rating shall be 42,000 A RMS symmetrical unless otherwise noted or determined by the Engineer.
 3. Acceptable Manufacturers: Square-D, Cutler-Hammer, General Electric, Siemens, or equal.
- N. Power Distribution Fuses
1. All fuses rated 600 volts and below shall be rejection type dual-element, time-delay type. Acceptable Manufacturers are Bussman, Littlefuse and Shawmut or equal.
 2. Fuses shall be U.L. Class and rating as shown on the drawings or as required by the manufacturer of the equipment they are protecting. In general, fuses shall be:
 - a. U.L. Class RK1 for service entrances and feeders supplying combination motor loads.
 - b. U.L. Class RK5 for motor branch circuits.
 3. Provide two (2) complete sets of fuses for all fusible disconnect switches.
- O. Ground Rods, Ground Cable, Ground Fittings
1. Ground Rods shall be copper-clad steel at least 3/4-inch in diameter and 10 feet long. The rods shall have a hard, clean, smooth, continuous, surface throughout the length of the rod.
 2. Ground System Cable and taps shall be copper stranded, sized as indicated on Drawings and/or in Section 16450. Exothermic welding connections shall be required for underground connections; mechanical fittings are acceptable for above ground connections only. Acceptable manufactures are Erico-Cadweld, Thomas & Betts-Blackburn, Galvan, or equal.
 3. Irreversible compression connectors must be factory filled with an oxide inhibitor and installed with the same manufacturers die so that the die index matches the listed index on the connectors. Connector must be fully crimped with a 14 ton or larger hydraulic tool so that the index number is indented on the connector. Connectors must comply with IEEE837, UL467 and CSA22.2. As manufactured by: Thomas & Betts-Blackburn, Hubbell-Burndy, Erico, or equal.
- P. Metal Framing Channel
1. Channel for all locations shall be roll formed from stainless steel AISI Type 316. Channel shall be 1-5/8” and comply with the following industry standards: NFPA70, Fed Spec: W-C-582, WW-H-171, MFMA-4, and ASTM B633
 2. Use stainless steel fittings and hardware of the same material as channel throughout the installation. Fittings shall be by same manufacturer. All

channel, materials, connections etc. shall be completely stainless steel the entire installation.

3. All metal framing channel ends shall be furnished and installed with insert type, plastic caps for the entire installation of this project at all ends of uni-strut channel for every section of channel used throughout the project no matter where it is installed. The over the top type plastic or rubber end caps are not acceptable and shall not be allowed or used anywhere for this project.
 4. Provide a complete 4" "C" angle stainless steel channel and stainless-steel mounting channel and stainless-steel hardware system as shown on the drawings and for all vertical supports. Refer to the electrical detail drawings for structural sizing and rigidity of "C" channel.
 5. Metal framing shall be B-Line Systems, Inc., Thomas & Betts-Super Strut, Unistrut, or equal.
 6. 4-inch, "C" channel shall be used for all vertical support. Uni-strut shall only be allowed for horizontal supports only and not vertical supports. Any use of Unistrut for vertical support shall be removed and replaced at the contractor's expense.
- Q. Link Seal
1. Conduit wall and floor seals for cored holes and sleeved openings shall be Link Seal, Innerlynx, Crouse Hinds, or equal. Refer to the contract drawings for additional requirements.
- R. Cable Seals
1. Conduit sealing bushings shall be OZ Gedney Co., Type CSB Series, Crouse Hinds, Killark, or equal.
- S. Conduit Seals-Offs
1. Provide Class I, Div. 1, Group D and Class 1, Div. 2 seals as required by the N.E.C. Material shall match the conduit in which being installed. Acceptable manufacturers are Appleton, Crouse-Hinds, Killark, or equal.
- T. Terminal Cabinet
1. The enclosure shall meet NEMA rating listed on Drawing E-1 which shall include a fully hinged door with a key lockable handle with no side clips around the edge. In no case shall enclosure be sized smaller than as indicated in the National Electrical Code for Conduit and Conductor sizes installed.
 2. Provide a lamacoid nameplate at the top center of the cabinet.
 3. All terminal strips shall be numbered on both sides and numbering shall not be repeated within the same enclosure. Provide tags to indicate destination of cable on either side of terminal connections.
 4. Provide an internal backboard for all enclosures
 5. Provide separate terminal strips for power, control, and signal wiring. Also provide separation between all terminal strips. In addition, separation and separate terminal strips shall be provided for 120V and 24V control wiring.
 6. Enclosure shall be free standing with the minimal dimensions as follows:
 - a. 30" inches high, 24" inches wide, and 12" inches deep. This will allow for future equipment to be installed.
 - b. Three-point key lockable handle.
 - c. Large nameplate at top center of panel.

- d. Numbered terminals with 25 percent spares.
- e. Numbered terminal strips to allow for additional equipment to be mounted on back panel and connections to this panel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Unless otherwise noted, wiring for all systems indicated in the Contract Documents shall consist of insulated conductors installed in raceways in accordance with the manufacturer's instructions.
 - 1. Raceways shall be continuous from outlet box to outlet box and from outlet box to cabinet, junction or pull box. Secure and bond raceways to all boxes and cabinets such that each system of raceways will be electrically continuous throughout.
 - 2. Contract drawing E-1 NEMA CLASSIFICATIONS FOR ELECTRICAL EQUIPMENT AND ENCLOSURES indicates the NEMA ratings of each location at the facility.
- B. Refer to the Conduit Installation Schedule on Drawing E-1 and the drawings for conduit type and installation use for the project.
 - 1. Use of Miscellaneous Conduit Types
 - a. Flexible "liquid tight" metal conduit shall be used for final connection to the following:
 - * all motors
 - * rotating or vibrating equipment
 - * dry type transformers
 - * recessed lighting fixturesLengths of liquid tight flexible metal conduit shall be kept to a minimum (12 to 18 inches) and maximum length of 2'-6" except when dictated otherwise by a particular installation approved by the Engineer and as allowed by NEC.
 - b. PVC Schedule 80 non-metallic conduit shall be used as shown on drawings.
 - c. Conductors for fire alarm circuits shall be routed in rigid galvanized steel conduit unless otherwise noted on the drawings. Minimum conduit size shall be ¾".
 - d. Metal Clad cable (MC) shall be installed in the following locations:
 - i. Used for whips for concealed lights above hung ceiling limited to 3' in length.
 - ii. Within studded concealed wood frame walls for receptacles and light switching.
 - 2. All signal wiring shall be installed in rigid galvanized steel or PVC coated rigid galvanized steel conduit.
- C. Requirements for Conduit Within Concrete
 - 1. Underground Raceways in Duct Banks:
 - a. All underground raceways shall be Schedule 40 heavy wall PVC conduit unless otherwise noted on the drawings. All signal conduits shall be installed within rigid galvanized steel conduit.
 - b. Encase all underground raceways in a concrete envelope.

- c. Refer to drawings for specific encasement duct bank details and requirements.
 - d. All underground duct banks where they are directed toward a building or structure shall transition from non-metallic conduit to metallic rigid galvanized conduit of the same diameter 15'-0" from the respective building or structure for all locations. The same type of metallic conduit shall continue to its final location per the NEMA rating of the areas that it is installed in. Provide proper transition connections for this change in conduit type. No exceptions will be allowed.
 - e. For all underground raceways, bottom of trench shall be solid undisturbed earth. Earth showing extensive signs of peat, cinders, rubble or any conditions not suitable for a stable foundation should be reported to the Engineer for recommendation. Small packets (up to 1 cu. yd.) of unsuitable soil shall be excavated and replaced with compacted gravel borrow maximum rock size 2 inches. In areas which have had fill work completed during the progress of work under this contract, verify that the bottom of trench is 95 percent compaction minimum. If compaction is less than 95 percent provide additional compaction in bottom of trench.
 - f. Provide underground electrical marking tape for the full length of all trenches for underground raceways. Marking tape shall be SETON #85517 Electrical, Telephone, or equal.
2. Raceways in Slabs:
- a. Raceways for embedment within a slab, wall or beam, other than those merely passing through, shall satisfy the following:
 - i. Power and control conduits shall be rigid heavy wall Schedule 40 PVC conduit.
 - ii. Instrumentation conduits shall be rigid galvanized steel or PVC-coated rigid galvanized steel conduit.
 - iii. Shall not be larger in outside diameter than one-third (1/3) the thickness of the slab, wall or beam.
 - iv. Raceways shall not be spaced closer than 3 diameters on center.
 - v. Shall not impair significantly the strength of the concrete.
 - vi. Conduits installed in slab on grade shall have a 3 inch concrete envelope and reinforcing and coverage all sides poured monolithic with the slab. Where raceways are going to remote locations it shall not be required to pour the envelope monolithic with the floor slab.
 - b. Raceways beneath above grade concrete slabs shall be supported from the underside of the structural slab by means of galvanized pipe hangers spaced 5'-0" on center, maximum. After installation pipe hangers shall be coated with asphalt mastic. Installation shall maintain integrity of waterproofing membrane.
 - c. Raceways which extend out from a slab, penetrate concrete floor slabs, walls, ceilings, etc., shall be PVC coated rigid galvanized steel and shall extend a minimum of 12-inches on both sides of the concrete structure prior to transitioning to an approved raceway material as specified for the specific location and NEMA area designated.

3. General Concrete Encasement of Raceways:
 - a. All concrete work required for concrete encasement of electrical duct banks shall be provided under Division 3 - Concrete, including all reinforcing steel requirements. All excavation and backfill for electrical duct banks shall be provided under Division 2 - Site Work. This Contractor shall coordinate all requirements noted herein with those Divisions for proper installation.
 - b. For all underground raceways, bottom of trench shall be solid undisturbed earth. Earth showing extensive signs of peat, cinders, rubble or any conditions not suitable for a stable foundation should be reported to the Engineer for recommendation. Small packets (up to 1 cu. yd.) of unsuitable soil shall be excavated and replaced with compacted gravel borrow maximum rock size 2 inches. In areas which have had fill work completed during the progress of work under this contract, verify that the bottom of trench is 95 percent compaction minimum. If compaction is less than 95 percent provide additional compaction in bottom of trench.
 - c. Form concrete envelope around raceways, 3 inch minimum thickness concrete at top, bottom and sides of duct bank 7-1/2 inch minimum center-to-center spacing between raceways. Concrete shall be full width of trench. Top raceway shall be not less than 30 inches below finished grade, except where under building slabs. Open trench for its complete length before concrete is poured; if any obstructions are encountered, make provisions to avoid them. Support raceways minimum 3 inches above bottom of trench before pouring concrete. Provide 12" separation between Power and Control/Signal conduits.
 - d. Refer to structural drawings for specific concrete encasement and reinforcing requirements and details. All duct banks shall be formed with wooden forms and no other method of installation shall be allowed. Coordinate with Division 2 and 3 for final installation.
 - e. Furnish and install precast concrete, plastic or fiber spacers in order to achieve consistent spacing between raceways. Stagger couplings. Securely tie raceways in place to prevent floating. Pour concrete as soon as possible after placing and securing of raceways.
 - f. Pull iron-shod mandrel, not more than 1/4 inch smaller than bore of raceway, through each raceway to remove concrete and other obstructions. Clean raceway by drawing through properly sized cylindrical brushes as many times as necessary to remove dirt.
 - g. All duct banks shall be installed to slope back to the respective manholes, handholes, etc. and away from buildings or structures.
- D. General Raceways Installation Requirements:
 1. Sized as indicated on the Drawings. Where sizes are not indicated, raceways shall be sized per the National Electrical Code in accordance with the quantity, size, type and insulation of conductors to be installed. However, raceways shall be minimum three quarter (3/4") trade size for all installation unless otherwise noted.

2. Provide adequate grounding between all outlets and the established electrical system ground. Bond conduit systems per NEC.
 3. Cut square, free of burrs due to field cutting or manufacture, and bushed where necessary. Spray all ends of threaded conduit with cold galvanizing spray compound.
 4. Installed with exterior surfaces not less than six inches (6") from any surface with a temperature of 200 degrees F or higher.
 5. Plugged at the ends of each roughed-in raceway with an approved cap or disc to prevent the entrance of foreign materials during construction.
 6. Concealed throughout except where exposure is permitted by the Engineer.
 7. Installed parallel or perpendicular to floors, walls and ceilings.
 8. Installed with a minimum of bends and offsets. All bends shall be made without kinking or destroying the cross section contour of the raceway. Factory made bends shall be used for raceways one-inch (1") trade size and larger.
 9. Installed with U. L. Listed raintight and concrete-tight couplings and connectors.
 10. Firmly fastened within three feet of each outlet box, junction box, cabinet or fitting. Raceways shall not be attached to or supported by wooden plug anchors or supported from Mechanical Work such as ductwork, piping, etc.
 11. Arranged in a neat manner for access and allow for access to work installed by other trades.
 12. If it is necessary to burn holes through webs of beams or girders, call such points to the attention of the Engineer and receive written approval both as to location and size of hole before proceeding with work. All holes shall be burned no larger than absolutely necessary.
 13. Where raceways puncture roof, install pitch pockets as required in order that the roof warranty is maintained.
 14. Where raceways penetrate fire-rated walls, floors, or ceilings, install firestops equal to the rating of the wall, floor, or ceiling, per specification section 07270, "Fireproofing".
 15. For Raceways installed outdoors:
 - a. Conduit entry shall not extend from above and turn down to the equipment causing a path of moisture or liquid to follow down to the equipment.
 - b. Install drip loops in liquid tight conduit connections and extend up to equipment to avoid moisture or liquid travel to the equipment.
 - c. Seal all conduits with duct seal or cable seals that extend from heated to non-heated locations at both ends of all conduits.
- E. Wiring Methods
1. Feeder conductors shall be continuous from point of origin to load termination without splice. If this is not practical, contact the Engineer and receive written approval for splicing prior to installation of feeder(s). Refer to Splicing Methods listed below.
 2. Do not pull conductors into raceways until raceway system, including all outlets, cabinets, bushings and fittings, is completed. Verify that all work of other trades which may cause conductor damage is completed. Use only U.L.

approved cable lubricants when necessary. Do not use mechanical means to pull conductors No. 8 or smaller.

3. In general, conductors shall be the same size from the last protective device to the load.
4. All wiring systems shall be properly grounded and continuously polarized throughout, following the color coding specified. Connect branch circuit wiring at panelboards, as required, in order to provide a "balanced" three-phase load on feeders.
5. All feeder connections shall be made to bus and other equipment using solderless, pressure type terminal lugs, as manufactured by Burndy, National, O.Z., T. & B., or equal.

F. Conduit Support

1. Support adequately by malleable iron pipe clamps or other approved methods. **In exterior or wet locations and along outside wall supports shall allow not less than, 1/4 inch, air space between raceway and wall.** Firmly fasten raceway within 3 feet of each outlet box, junction box, cabinet or fitting. The following table lists maximum spacing between supports. Additional supports may be required due to field conditions, strength of supporting members, etc. Furnish and install such supports at no additional cost to Owner.

<u>Conduit Trade Size</u>	<u>Type of Run</u>	<u>Horizontal Spacing in Feet</u>	<u>Vertical Spacing in Feet</u>
3/4"	Concealed	7	10
1", 1-1/4"	Concealed	8	10
1-1/2" & lgr.	Concealed	10	10
3/4"	Exposed	5	7
1", 1-1/4"	Exposed	7	8
1-1/2" & lgr.	Exposed	10	10

G. Installation of Concrete Envelope

1. Wherever a cluster of three (3) or more raceways rise out of floor exposed, provide neatly formed 6" high concrete envelope with chamfered edges around raceways.

H. Installation of Spare Conduits

1. At each flush mounted panel-board, terminal cabinet, control cabinet, etc., provide four (4) spare three-quarter inch (3/4) raceways from panel-board, etc. to an area above the nearest accessible ceiling space and floor space in the specific room location. Make 90 degree turn above the ceiling or below the floor and cap all conduits.
2. Where drawings indicate a "Spare" conduit, install a #14 AWG fish wire in all runs to facilitate future installation of conductors.

I. Installation of Bushings and Grounding Bushings

1. Provide grounding type insulated bushings on all power conduits regardless of size.
2. Provide grounding type insulated bushings on all control conduit sizes and signal conduit sizes one and one-quarter inch (1-1/4") trade size and larger.

3. Provide standard bushings for conduits one inch (1") and smaller unless otherwise stated.
 4. Install cable seal bushings in conduits for all outdoor locations and NEMA 4X locations to prevent moisture from entering enclosures and equipment.
 5. Install cable seals in all conduits where there is a change in temperature such as transitioning from a room to the attic.
 6. Provide a bushing at each conduit termination unless fitting at box where conduit terminates has hubs designed in such a manner to afford equivalent protection to conductors.
 7. Any installations not provided with these requirements shall be removed and reinstalled at no additional cost to the Owner.
- J. Myers Hubs
1. Myers hubs shall be installed on junction boxes and enclosures which do not have cast hubs in non-classified areas.
- K. Expansion Fittings
1. All conduit installations where conduits extend up out of the ground at buildings, structures or equipment shall be provided with expansion fittings.
 2. Expansion/deflection type fittings shall be provided at all horizontal or vertical expansion joints, located in new or existing buildings and structures.
- L. Conduit Seals
1. Conduit seals shall be installed in all explosion proof areas Class 1 Division 1, and Class 1, Division 2 areas. The conduit seal shall be installed per the National Electric Code Article 501.15 as well as what is shown on the drawings.
 2. Upon installation of sealant, the contractor shall mark the conduit seal with a black, permanent marker to indicate that the conduit seal is filled properly.
- M. Link Seals
1. All penetrations through existing and new concrete floors, and walls shall be core drilled and sleeved, and installed with a link seal.
 2. Refer to all details shown on the Contract Drawings for conduit sealing fittings and weatherproof conduit seals. All conduit penetrations are required to be provided with seals as noted on the Contract Drawings and as specified. Any installations not provided with these requirements shall be removed and reinstalled at no additional cost to the Owner.
- N. Raceways through Wall Bond Outs
1. In specific areas wall bond outs have been designed and shown on the electrical and structural drawings for conduit installations.
- O. Splicing Methods
1. Feeder conductors shall be continuous from point of origin to load termination without splice. If this is not practical, contact the Engineer and receive written approval for splicing prior to installation of feeder(s).
 2. For splices and taps, No. 10 AWG and smaller, use solderless "Thread-On" connectors having spiral steel spring and insulated with a vinyl cap and skirt, as manufactured by 3M Co. (pre- insulated "Scotch-Lock") or Ideal ("Wing-Nuts").
 3. For splices and taps, No. 8 and larger, use solderless "Split Bolt" type connector as manufactured by Anderson, Burndy, Kearney, Thomas & Betts, or equal.

4. Use cast connections, Cadweld or Thermoweld, for ground conductors.
 5. Make all splices and connections in accessible boxes and cabinets only.
 6. Cover uninsulated splices, joints and free ends of conductor with rubber and friction tape or PVC electrical tape. Plastic insulating caps may serve as insulation.
 7. Where feeder conductors pass through junction and pull boxes, bind and lace conductors of each feeder together. For parallel sets of conductors, match lengths of conductors as near equal as possible.
 8. Branch circuit conductors installed in panelboards, and control conductors installed in control cabinets and panels shall be neatly bound together using "Ty-Raps" or equal.
 9. Underground Splicing
 - a. This work will require that all splices be tested and also provide the splices with a compression connector on the conductor. Insulate and waterproof using one of the following methods which are suitable for continuous submersion in water:
 - b. Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulation in a packaged form ready for convenient mixing without removing from the package.
 - c. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced when the mold is in place around the joined conductors, prepare the resin mix and pour into the mold.
 - d. Provide heavywalled heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which shall be applied by a clean burning propane gas torch.
 - e. Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation shall not require heat or flame, or any additional materials such as coverings or adhesives. It shall be designed to be used with in-line compression type connectors, indoor, outdoor, direct-burial or submerged locations.
- P. Installation of Ceiling Hung Devices
1. Lighting fixtures, detectors, etc., in Mechanical Equipment, Boiler and Pump Rooms shall be installed with exposed conduit after equipment, ductwork, piping, etc., are in place.
- Q. 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.

R. Light Switches

1. All light switches shall be installed in close proximity of the door opening where indicated on drawings. Where lights are shown adjacent to strike side of door, locate edge of switch box approximately 6 inches from door frame.
2. Install cover plates for all single and multi-gang switch boxes for all light switches.

S. Outlet Boxes

1. On termination at branch circuit outlets, leave a minimum of eight inches (8") free conductor for installation of devices and fixtures.
2. Consider location of outlets shown on Drawings as approximate only. Study Architectural, Mechanical, Plumbing, Process, and Structural Drawings and note surrounding areas in which each outlet is to be located. Locate outlet so that when fixtures, motors, cabinets, equipment, etc., are placed in position, outlet will serve its desired purpose. Where conflicts are noted between Drawings, contact Engineer for decision prior to installation. Comply with Article 314 of National Electrical Code relative to position of outlet boxes in finished ceilings and walls.
3. Prior to installation, relocate any outlet location a distance of five feet in any direction from location indicated on Drawings if so directed by the Engineer. Prior to completion of wall construction, adjust vertical height of any outlet from height indicated if so directed by Engineer. The above modifications shall be made at no additional cost to the Owner.
4. Where outlets at different mounting heights are indicated on Drawings adjacent to each other (due to lack of physical space to show symbol on Drawings), install outlets on a common vertical line.
5. Where switch outlets are shown adjacent to strike side of door, locate edge of outlet box approximately 3 inches from door frame.
6. Outlet boxes in separate rooms shall not be installed "back-to-back" without the approval of the Engineer.
7. Outlet boxes installed in plaster, gypsum board or wood paneled walls shall be installed with raised plaster covers or raised tile covers.
8. Outlet boxes installed in tile, brick or concrete block walls shall be installed with extra-deep type raised tile covers or shall be 3-1/2 inches deep boxes with square corners and dimensions to accommodate conductors installed.
9. Surface ceiling mounted outlet boxes shall be minimum 4 inches square, 1-1/2 inches deep, galvanized sheet metal.
10. Surface wall mounted outlet boxes shall be cast type boxes having threaded or compression type threadless hubs. Exterior boxes shall be cast type with threaded hubs and gasketed cover plates secured by non-ferrous screws.

11. Install a device cover plate over each and every outlet indicated on Drawings. Do not install plates until painting, cleaning and finishing of surfaces surrounding the outlet are complete. Cover plates shall completely cover all edges of openings in the wall around the outlet box for a neat/finished installation.

T. Junction and Pull Boxes

1. Install junction and pull boxes in readily accessible locations. Access to boxes shall not be blocked by equipment, piping, ducts and the like. Provide all necessary junction or pull boxes required due to field conditions and as required by the National Electrical Code, Article 314.

U. Equipment Mounting Heights

1. Unless otherwise noted, mount devices and equipment at heights measured from finished floor to device/equipment base as follows: (Device base to be set at CMU joint unless otherwise noted. The Contractor shall verify all dimensions noted with the Engineer for final approval prior to performing or installing any of this work.)

a. Toggle switches (up position "on")	48"
b. Receptacle outlets (long dimension vertical,	
c. ground pole nearest floor)	16"
d. Receptacle outlets, above baseboard heaters	30" min.
e. Receptacle outlets, hazardous areas	48"
f. Receptacle outlets, at countertops	48"
g. Receptacle outlets, weatherproof, above grade	24" min.
h. Telephone/intercommunication outlets, wall mounted	48"
i. Telephone and data outlets and cable T.V. outlets	16"
j. Fire alarm manual station	48"
k. Fire alarm Audio/Visual Station	96"
l. Branch circuit panelboards, to top of backbox	72"
m. Distribution panelboards, to top of backbox	72"
n. Terminal cabinets, control cabinets, annunciator panels, to top of backbox	72"
o. Disconnect switches, motor starters, enclosed circuit breakers, to top of box	60"

2. Where structural or other interferences prevent compliance with mounting heights listed above, consult Engineer for review to change location before installation.

V. Hangers and Supports

1. Provide steel angles, channels and other materials necessary for the proper support and erection of motor starters, distribution panelboards, large disconnect switches, pendant-mounted lighting fixtures, etc.
2. Panelboards, cabinets, large pull boxes, cable support boxes and starters shall be secured to ceiling and floor slab and not supported from conduits. Small panelboards, etc., as approved by Engineer, may be supported on walls. Racks for support of conduit and heavy electrical equipment shall be secured to

building construction by substantial structural supports with PVC end caps as noted above.

3. All vertical supports for stanchion mount structures and control stations shall be 4" angle channel.
 4. Provide PVC end caps for all protruding angles, channels, struts, etc. for personal safety for the entire project installation.
- W. Identification of Conduit Systems
1. Provide lamacoid nameplates to mark intrinsically safe conduit systems for all applicable conduit systems for project.
- X. Grounding Connections
1. Exothermic welding connections shall be provided for underground connections.
 2. Mechanical fittings and irreversible compression fittings shall be provided for above ground connections.
 3. Make connections to equipment with mechanical connections shall be made by means of approved bronze clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A, or equal.

3.2 TESTS

- A. For testing requirements, refer to Section 16950.
- B. For grounding requirements, refer to Section 16450.

END OF SECTION

SECTION 16106CABINETS AND ENCLOSURESPART 1 - GENERAL1.1 DESCRIPTION

- A. The purpose of this Specification is to provide details of cabinets and enclosures for non-hazardous indoor and outdoor locations which will protect internal equipment from environmental conditions. This section is also to intend to provide consistency between enclosures supplied under different Divisions of this Contract. An exception is control panels provided by Division 11 and Division 13 which are specified within their specifications.

1.2 QUALITY ASSURANCE

- A. Supply cabinets and enclosures in accordance with the following:
1. Underwriter's Laboratory, Inc. listed.
 2. National Electrical Manufacturers Association Standard 250-1991.
 3. American National Standards Institute.
 4. National Electrical Code.
- B. Cabinets and enclosures supplied under this Section shall conform to the requirements of Specification Section 16010, "Quality Assurance".
- C. Stock cabinets and enclosures shall be manufactured by Hoffman Engineering Company, Saginaw Control and Engineering or approved equal. Custom fabricated enclosures shall be equal in quality, appearance and performance to stock enclosures. All enclosures shall be subject to the review of the Engineer.

1.3 RELATED WORK

- A. Additional details for panels and enclosures associated with process equipment are provided in the individual specification sections in Division 11.
- B. Additional details for panels and enclosures associated with HVAC equipment are provided in the individual specification sections in Division 15.
- C. Miscellaneous panel and enclosure auxiliary equipment, such as lights, switches, receptacles, fuses, etc. are contained in Section 16050, 16900, and as noted on the Contract Drawings.

1.4 REFERENCES

- A. ASTM C177 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- B. ASTM D149 - Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
- C. ASTM D256 - Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
- D. ASTM D495 - Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation.
- E. ASTM D570 - Test Method for Water Absorption of Plastics.

- F. ASTM D638 - Test Method for Tensile Properties of Plastic.
- G. ASTM D648 - Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
- H. ASTM D790 - Test Method of Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- I. ASTM D792 - Test Method for Density and Specific Gravity (Relative Density) of Plastic by Displacement.
- J. UL94 - Test for Flammability of Plastic Materials for Parts in Devices and Appliances.
- K. UL508A - Industrial Control Panels.
- L. The enclosures shall meet all requirements for UL508A - Industrial Control Panels as follows:
 - 1. All components within the enclosures shall be UL Listed and Labeled.
 - 2. The enclosure and all components as an entire "assembly as a system" shall be UL Listed and Labeled as UL508A compliant.

1.5 SUBMITTALS TO THE ENGINEER

- A. Shop drawings for this section are not required. The items listed below shall be included with the specific control being submitted to show compliance with this section in order to perform a complete review for equipment being submitted.
 - 1. Provide documentation, as applicable, from a UL certified fabricator that the control panel has been tested, fabricated, and labeled as a complete functioning system and is in compliance with all UL listings and standards.
 - 2. Scaled and dimensioned enclosure layout drawings (internal and external) along with catalog cut sheets shall be provided.
 - 3. Enclosure NEMA ratings, project specific identification, where located, etc., shall be clearly and properly identified on each panels cut sheet.
 - 4. Listing of all accessories to be furnished with each panel and properly identified.
 - 5. Provide a complete wiring diagram for all items located within the enclosure such as panel lights, duplex receptacles, panel heaters, cooling fans, relays, control devices, protective devices, etc., where applicable.
 - 6. Provide heating requirement calculations for all exterior panels and panels located in unheated spaces, and cooling requirement calculations for heat dissipation from panels containing VFD's and other heat generating equipment as necessary.
 - 7. Submit all control panel faceplate arrangements for review and acceptance.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Delivery, storage and handling of electrical/instrumentation cabinets, enclosures and equipment contained within shall be in accordance with the general conditions Specification 11000 and specification 16010.
- B. Replace or repair, to the satisfaction of the Engineer, any cabinets and enclosures which are defective or have been damaged during storage or installation, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General for all Enclosures:

1. NEMA classifications for panels and enclosures shall be as noted on Drawing E-1, unless otherwise specifically called out within the Drawings or Specifications.
2. Panels and enclosures shall be furnished factory-wired and tested with all equipment and appurtenances mounted thereon.
3. Control panels and enclosures shall be U.L. listed and labeled as a complete and functioning system.
4. Panels larger than 36-inches in any dimension shall not be wall mounted.
5. Provide two doors if panel is larger than 36-inches wide.
6. Refer to the drawings and pertinent specifications for minimum control panel faceplate requirements. In the absence of specific details, faceplates shall be arranged in such a manner as to provide a neat, workable and operator friendly panel.
7. Doors shall have side mounted, stainless steel, continuous length, piano-type hinges and pins.
8. Latches shall be T-handle or quick-release type only. Latches which require use of tools or coins for access, utilize wing-nuts, clips around the outside of enclosure etc., will not be acceptable.
9. Panels/enclosures shall be equipped with map pockets located on the inside of the door.
10. Enclosures shall be equipped with provisions for locking the access doors.
11. Enclosures shall be sized as required to contain the necessary apparatus for the particular installation except as noted on the drawings. Final panel/enclosure dimensions shall provide for easy access and workability to all internal components with ease of maintenance and future modifications considered. Conflicts with panel sizing and available spacing shall immediately be brought to the attention of the Engineer prior to proceeding.
12. Provide door and body stiffeners where necessary for a rigid enclosure. Large 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.
13. Enclosures larger than 16 inch in any dimension shall utilize a three point latching system.
14. Enclosures 16 inch wide and larger shall be equipped with heavy duty, zinc plated stop arm kits to lock the external door in the open position.
15. Panel front-mounted pilot lights, selector switches, push button control stations and appurtenances shall be provided in accordance with Section 16900.
16. Where required, enclosures shall be provided with an interior panel, painted white, for mounting of internal components.

B. General NEMA Class and Requirements for Indoor Installations:

1. NEMA Type 1 Enclosures
 - a. Enclosures shall be sheet steel, 16 gauge for box widths up to and including 18", 14 gauge for box widths of 24", and 12 gauge for box

- widths of 30" and greater. Enclosures shall have continuously welded seams ground smooth; supplied with or without knockouts and shall have door and body stiffeners where necessary for a rigid enclosure.
- b. Panels/enclosures shall be factory coated inside and out with ANSI 61 gray polyester powder coating over phosphatized surfaces.
2. NEMA Type 12 Enclosures:
 - a. 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.
 - b. Provide oil-resistant door gaskets.
 - c. Enclosures shall be coated inside and out with ANSI 61 gray over phosphatized surfaces.
 3. NEMA Type 3R Enclosures:
 - a. Type 3R enclosures shall not be used to house controls or electronics that require heating. See the specific "Special Requirements" for outdoor panels below.
 - b. Enclosures shall be steel, 16 gauge for box widths up to and including 12", 14 gauge for box widths between 15" and 24", and 12 gauge for box widths of 30" and greater. Free-standing enclosures shall be 12 gauge minimum. Enclosures shall have drip shield top; seam free sides, front, and back; and furnished with knockouts or factory installed cut outs in bottom only.
 - c. Panels/enclosures shall be factory coated inside and out with prime and finish coats. Finish coat color to be ANSI 61 gray. Two prime coats shall be applied. Prime coat shall be rust inhibitive primer equal to Koppers Inertol Rust inhibitive Primer 621. Finish coat shall be compatible with prime coat and shall be an alkyd applied in two coats with a minimum dry film thickness of 1.5 mils per coat. Alkyd coating shall be equal to Koppers Glamortex 501 Enamel. Surface preparations shall be in accordance with manufacturer's requirements.
 4. NEMA Type 4 Enclosures:
 - a. 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. Provide with door and body stiffeners as required for a rigid installation and with rolled lip around door and enclosure opening. Enclosures to be installed outdoors shall be provided with drip shields.
 - b. Provide oil-resistant, water tight door gaskets.
 - c. Enclosures shall be factory coated inside and out with prime and finish coats. Finish coat color to be ANSI 61 gray. Two prime coats shall be

applied. Primer shall be rust inhibitive primer equal to Koppers Inertol Rust inhibitive Primer 621. Finish coat shall be compatible with prime coat and shall be an alkyd applied in two coats with a minimum dry film thickness of 1.5 mils per coat. Alkyd coating shall be equal to Koppers Glamortex 501 Enamel. Surface preparations shall be in accordance with manufacturer's requirements.

5. NEMA Type 4X Enclosures:
 - a. Type 4X enclosures shall be stainless steel or aluminum. No other metals will be allowed.
 - i. 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.
 - ii. Aluminum enclosures shall be type 5052 H-32 aluminum, minimum 0.080-inch thick.
 - b. Metal enclosures shall have continuously welded seams, ground smoothed.
 - c. Enclosures shall be supplied with no holes or knockouts; shall have door and body stiffeners where necessary for a rigid installation and a rolled lip ground door and enclosure opening.
 - d. Enclosures to be installed outdoors shall be provided with drip shields.
 - e. Provide oil-resistant door gaskets all around door openings. All enclosure hinges, clamps, etc. shall be stainless steel.
 - f. Enclosures shall be provided unpainted, with metal enclosures having a smooth brushed finish.

C. Special Requirements

1. Enclosures located in unheated spaces or general outdoors
 - a. When components requiring a minimum temperature in which to operate, such as solid state devices, are to be installed inside the enclosure, the enclosure shall be NEMA 4X or NEMA 4 minimum when not available.
 - b. The enclosures shall be insulated. 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.
 - c. Enclosures shall be equipped with a factory installed built-in heater and adjustable thermostat. Field installations after the fact will not be acceptable. The heater shall be sized to maintain the temperature inside the panel at 40°F (or higher if required) with an outside ambient temperature of -30°F and a 15 MPH wind. 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. Heater shall be similar to Hoffman Engineering Co. series D-AH, Genesis automation, or approved equal.
 - d. Provide strip heater with thermostat for condensation control.

- e. Provide heating requirement calculations for review and acceptance to be included as part of the shop drawing review for this equipment.
 - f. Enclosures shall have a lockable outer door with a separate hinged NEMA 1 dead front inner door.
 - g. The panels inner door latches shall be T-handle or quick release type only.
 - h. All control devices and the main circuit breaker operating handle shall be mounted through the interior panel door. The main circuit breaker handle shall have a lock arrangement to prevent the inner door from being opened when in the "on" position.
 - i. Enclosures 16 inch wide and larger shall be equipped with heavy duty, zinc plated stop arm kits to lock the external door in the open position.
2. Instrument and Control Panels
- a. All instrument and control enclosures shall have the proper NEMA rating for the areas in which they will be installed or as specified in Division 11.
 - b. All front-mounted instruments and devices shall be installed in such a way as to maintain the NEMA rating of the enclosure.
 - c. Panels which are to be installed outdoors shall meet the special requirements of "Outdoor Control Panels and Panels located in Unheated Spaces".
 - d. Panels shall be supplied with a GFI type duplex convenience receptacle and a panel light with an easily accessible on-off switch. 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.
 - e. Panel lights for panels located in outdoor or unheated spaces shall a 32W fluorescent lamp with a low temperature starting ballast.
 - f. Panel lights for panels located in heated spaces shall be a 32 watt fluorescent lamp with protective lens. The length of the lamp shall be a minimum of 75% of the width of the enclosure.
 - g. Provide a separate, dedicated, single pole receptacle for connection of the UPS System as required. This receptacle shall be labeled - "For UPS System Only".
3. Special Cooling Requirements
- a. Enclosures which contain Variable Frequency Drives 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.
 - i. Cooling fans with dust filters, for NEMA 1 enclosures.
 - ii. Heat exchangers with circulating fans and filters, for NEMA 12 enclosures.
 - iii. Air conditioners, for NEMA 12 enclosures in areas with high ambient temperatures.
 - iv. Air Conditioners, for NEMA 4X enclosures in both 4X areas and 4X-corrosive areas shall be cooled with the use of a side mounted

air conditioner. The air conditioner shall be controlled by an internal thermostat in parallel with the run contact.

- v. Air conditioners shall have a drain tubing installed in order to drain to the nearest floor drain. Tubing shall be plastic PVC flex tube or PVC schedule 40.
 - b. Cooling fans shall be wired such that they only operate when the VFD or heat producing equipment is running.
 - c. Air conditioners where used in enclosures shall operate off of an internal thermostat.
 - d. 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.
- D. Nameplate/Identification:
1. All panels/enclosures, and all contained equipment/instrumentation shall be provided with a nameplate providing project specific identification of the unit or device. Identification wording shall be as noted on the drawings. In the absence of specific identification of name tag wording, provide general descriptive information of unit function.
 2. Provide nametags as specified in 16010.
 3. Name tags shall be permanently mounted below panel mounted items (interior and exterior as appropriate), or in as appropriate location as to clearly identify its function.
- E. Control Panel Wiring:
1. All wiring shall conform to the latest requirements of NEC, all state and local code requirements, and as described on the Drawings and in the Contract specifications.
 2. 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 U.L. 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.
 3. Bundles of wires must be secured to the panel structure every 8 inches minimum. All interior wiring will be point to point with no splices.
 4. Shielded wire shall be separated from other wires and equipment with suitable barriers and with terminal blocks for continuous shield grounding to the connecting cables.
 5. Intrinsically safe wiring shall be separated by barriers from all other wiring and shall be identified as required by the N.E.C. and installed with proper separation per U.L. 508A requirements.
 6. 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.

7. All wires shall be marked at both ends with numbers by self-sticking wire markers or with slip-on style plastic markers. Color coding shall include the following:
 8. Red wires - Interior control circuits
 9. Orange wires - Interlocks powered from external sources
 10. Blue wires - DC voltages
 11. See Section 16020 for additional color coding.
 12. Terminals shall be arranged in alphabetic and numeric order in columns on removable subplates. 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:
 - a. Power terminals - 2 spares
 - b. Control terminals - 10 spares
 - c. Signal terminals - 12 spares
 13. Provide ground terminal for each panel.
 14. 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.
 15. All control panels shall be provided with an appropriately sized surge arrester to protect panel internals. Surge arrester shall be equal to Square D Model SDSA1175 or Model SDSA3650 (as applicable) in quality and appropriately sized for function.
 16. All control panels will be suitable for use with 120V, 1 phase power, unless noted otherwise on the Drawings. The panels shall be equipped with an internal power supply fuse or circuit breaker and a thru-the-door, lockable, disconnect switch. Fuse blocks will be provided as required to allow a separate fuse for each piece of equipment within the panel requiring power.
 17. Provide complete "As Built" wiring diagrams to be provided with the O&M manuals and in the enclosures for all control panels.
 18. All wiring entering and leaving control panels shall be terminated on field terminal blocks and labeled.
 19. Provide large letter lamacoid plastic name plate as specified in 16020 at the top center of each control panel with properly identified nametag which corresponds to the contract designation name. Verify final name designation with the Engineer prior to installation.
- F. Spare Parts/Materials:
1. Provide 1 gallon of paint for each enclosure/panel topcoat color utilized.
 2. Provide the following spare parts for each panel/enclosure provided. Spare parts shall be contained in the panel/enclosure in such a manner as to permit accessibility and prevent accidental damage without interfering with internally mounted equipment.
 - a. Provide 10 of each lamp type used.
 - b. Provide one of each type relay used.
 - c. Provide one control switch, indicating light and/or push-button of each type used.
 - d. Provide 1 set of each fuse type and size used.

- e. Provide 1 of each color and type light lens used.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All interconnecting wiring between panels, unless specifically detailed otherwise on the drawings, shall be installed by the electrical contractor regardless of source of the panel itself. All conduit, wiring and installation requirements for each enclosure shall be completely and thoroughly coordinated with all applicable trades prior to equipment installation.
- B. Install enclosures in locations as shown on the Drawings.
 - 1. All floor mounted enclosures either free standing or on floor stands shall be mounted on a 4" high, concrete, maintenance pad.
 - 2. Securely fasten each floor mounted enclosure to the maintenance pad.
 - 3. Small enclosures may be supported on walls using stainless steel metal framing channels or similar hardware to provide a minimum 1/4 inch air space between enclosure and wall.
- C. Equipment Mounting
 - 1. All framing channels and mounting hardware shall be stainless steel - no exception.
 - 2. Use stainless steel fittings and hardware of the same material as the channel. All fittings supplied shall be by same manufacturer as the channel.
 - 3. Provide cross bracing as required using unistrut securely fastened to the mounting structure or building structure to provide for a rigid mounting assembly.
 - 4. The ends of all framing channels/strut shall be provided with PVC end caps for protection of personnel.
 - 5. Backboards used for mounting of equipment shall be constructed of 3/4 inch thick fiberglass, unless otherwise specified on the drawings.
 - 6. All channels or unistrut installed in such a manner that parts are located below grade shall be coated with a black bitumastic waterproofing material for the below grade portion and extending a minimum of 6 inches above grade. The exposed portion of the channel shall be taped off prior to coating for a neat, even, finished appearance.
 - 7. NEMA 4X installations require a 1/4" spacer between the enclosure and mounting support to prevent moisture from collecting.
- D. Equipment mounting heights shall be as shown on the contract drawings or the tops placed a maximum of 72 inches above finished floor or platform when the elevation is not shown.
- E. Provide special protection for all devices and terminal blocks when cutting, drilling, and/or installing any device in the control panel.
- F. All conduits entering exterior enclosures or in NEMA 4X environments shall be suitable gasketed on the outside and conduits shall be sealed (inside) using a pliable duct seal to prevent the entrance of water.
- G. All lifting eyes, hooks, brackets, devices etc., used to install, lift, transport, etc., the control panel shall be removed after installation and all resultant holes shall be plugged with threaded bolts for a finished, permanent installation. All methods of

plugging the holes shall maintain the NEMA rating of the enclosure.

3.2 TESTS

- A. Testing of the enclosures themselves is not required, however, all equipment and controls which are mounted in or on the enclosures shall be tested as a complete assembly as specified in the applicable sections of DIVISIONS 11, 14, 15 and 16.
- B. Each enclosure shall be fully tested by the manufacturer.

3.3 CLEANING

- A. Do not allow excess debris, water or other fluids to accumulate inside the enclosures during the course of construction.
- B. Upon completion of the work, remove all debris and surplus materials from inside the enclosures and leave them clean.
- C. Clean all enclosure surfaces and touch up any scratched or damaged areas to the satisfaction of the Engineer.
- D. Clean or replace all filters located in enclosures which contain ventilation fans.

END OF SECTION

SECTION 16415AUTOMATIC TRANSFER SWITCHPART 1 - GENERAL1.1 DESCRIPTION

- A. Furnish the automatic transfer switch to automatically transfer between the normal and emergency power source as indicated on the contract drawings and specified within. The equipment shall be new, factory tested, and pre-wired when delivered to the site.
- B. The transfer switch shall be designed, built, tested, furnished, and warranted by the manufacturer of the generator supplier.

1.2 QUALITY ASSURANCE

- A. The automatic transfer switch covered by these specifications shall be designed, tested, and assembled in strict accordance with all applicable standards of ANSI, U.L., IEEE and NEMA.
- B. An approved transfer switch manufacturer shall have been regularly engaged in the production of U.L. (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.
- C. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit Shop Drawings for all transfer equipment, in their entirety, specified herein including the following information:
 1. Manufacturer and equipment type.
 2. Standard catalog information sheet.
 3. Detailed Shop Drawings indicating plan, elevation, end, and isometric views.
 4. Wiring diagram.
 5. Complete bill of materials.
 6. Additional information necessary to verify equipment to be supplied has features specified.
 7. 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.

1.4 REFERENCE TO OTHER SECTIONS

- A. Refer to Section 16010 for shop drawing formatting requirements.
- B. Refer to Section 16010 for identification nameplates requirements.
- C. Refer to Section 16010 for coordination, short circuit, and arc flash study requirements.

D. Refer Division 13 for Seismic Requirements.

1.5 WARRANTY

A. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of five (5) years from the date of installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. The enclosure shall be wall mounted, with NEMA rating as shown on Drawing E-1 based on equipment location. There shall be no mechanical side clips around the front or sides of the enclosure.
2. Transfer switch shall be 60 Hz. Refer to drawings for the number of transfer switches, number of phases, number of poles, voltage, and ampere rating requirements. This shall be a 120/240 volt, single phase normal and emergency (stand-by) transfer switch which is sized and as shown on the drawings.
3. The transfer switch shall have a key lockable handle installed on the front door and shall not have any mechanical clips around the outside of the enclosure.
4. Transfer switch shall be rated to carry 100 percent of their rated current continuously when in an enclosure. Transfer switch which must be derated when installed in an enclosure (due to integral overcurrent devices or any other reasons) do not meet this specification. Transfer switch shall be rated for continuous operation in ambient temperatures of -40° C (-40°F) to 67°C (142°F).
5. All transfer switches shall be U.L. 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 U.L. 1008 Standard.
6. The application of this transfer switch shall also see single to three phase conversions of the load at each of the motors being operated on the project. Refer to the single line diagram and drawings for additional requirements.
7. Withstand and Closing Ratings
 - a. The automatic transfer switch shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.
 - b. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.
 - c. 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 CURRENT RATINGS	K & J/L* FUSES	WITHSTAND AND CLOSING RATINGS
40A, 70A, 100A	125A/200A*	14,000A RMS

150A, 260A	400A/600A*	30,000A RMS
400A, 600A	1200A/1200A*	65,000A RMS
800A, 1000A	2000A/2000A*	65,000A RMS

* Class J and L Fuses WCR = 200,000A RMS

8. Transfer switches with in-phase monitoring for switching between sources are not acceptable and do not meet this specification.
- B. Construction:
1. Transfer switch shall be a programmed delayed transition switch with center "off" position operation, double-throw construction. Switch shall be positively electrically and mechanically interlocked by a mechanical beam to prevent simultaneous closing (for break before make operation), and mechanically held in both normal and emergency positions. The transfer switch shall move to a neutral position before transferring to the Normal or Emergency position.
 - a. Transfer switch 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 switch shall provide a center "Programmed Transition Off" position for manual switching.
 - b. Transfer switch 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, 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 switch 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 key locking cabinet door. Transfer switches located on the outside of the cabinet do not meet this specification.
 - g. Maximum transfer time in either direction shall be six (6) cycles, except where the "Programmed Transition" feature is furnished.
 - h. 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".
 - i. 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.

- j. Transfer switch shall have one (1) S.P.D.T. (Single Pole Double Throw), auxiliary switch on both the normal and emergency-sides, operated by the transfer switch. These auxiliary switches 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.
 - k. Complete AL-CU (Aluminum-Copper) lugs, U.L. listed and CSA certified, shall be provided for both normal and emergency load positions. 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 2011 NEC Table 312.6(b). Full rated neutral bar with lugs for normal, emergency, and load neutral conductors shall be provided inside the cabinet.
 - l. Relay, with 2 N.O. and 2 N.C. contacts that is energized whenever the normal source is available regardless of switch position.
 - m. Relay with 2 N.O. and 2 N.C. contacts that is energized whenever the emergency source is available regardless of switch position.
- C. Transfer Switch Control (Level II):
- 1. CONTROL PANEL

Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be a sealed membrane panel rated NEMA 3R / IP53 or better that is permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities:

 - a. High intensity LED lamps to indicate the source that the load is connected to (Source 1 or Source 2); and which source(s) are available. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.
 - b. High intensity LED lamps to indicate that the transfer switch is “not in auto” (due to control being disabled or due to bypass switch {when used} enabled or in operation) and “Test/Exercise Active” to indicate that the control system is testing or exercising the generator set.
 - c. “OVERRIDE” pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.
 - d. “TEST” pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.
 - e. “RESET/LAMP TEST” pushbutton that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.
 - f. The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via a PC-based service tool or an operator display panel.

- g. Security Key Switch to allow the user to inhibit adjustments, manual operation or testing of the transfer switch unless key is in place and operated.
 - h. Vacuum fluorescent alphanumeric display panel with pushbutton navigation switches. The display shall be clearly visible in both bright (sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The alphanumeric display panel shall be capable of providing the following functions and capabilities.
2. CONTROL PANEL DISPLAY REQUIREMENTS
The control panel shall be able to display the following:
- a. Display source condition information, including AC voltage for each phase of normal and emergency source, and frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance.
 - b. Display source status, to indicate source is connected or not connected.
 - c. Display load data, including 3-phase AC voltage, frequency, kW, kVA, and power factor. Voltage data for all phases shall be displayed on a single screen.
 - d. The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:
 - i. Set nominal voltage and frequency for the transfer switch.
 - ii. Adjust voltage and frequency sensor operation set points.
 - iii. Set up time clock functions.
 - iv. Set up load sequence functions.
 - v. Enable or disable control functions in the transfer switch, including program transition.
 - vi. Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.
 - e. Display Real Time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
 - f. Display service history for the transfer switch. Display source- connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.
 - g. Display information for other transfer switches in the system, including transfer switch name, real time load in kW on the transfer switch, current source condition, and current operating mode.
 - h. Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to close on retransfer, battery charger malfunction, network battery voltage low, network communications error.
3. INTERNAL CONTROL REQUIREMENTS:

- a. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600VAC. Provide RMS voltage sensing and metering that is accurate to within plus or minus 1% of nominal voltage level. Frequency sensing shall be accurate to within + 0.2%. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
- b. Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:
 - i. Monitoring all phases of the normal service (Source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of normal voltage level).
 - ii. Monitoring all phases of the emergency service (Source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of pickup voltage level).
 - iii. Monitoring all phases of the normal service (Source 1) and emergency service (Source2) for voltage imbalance.
 - iv. Monitoring all phases of the normal service (Source 1) and emergency service (Source 2) for loss of a single phase.
 - v. Monitoring all phases of the normal service (Source 1) and emergency service (Source 2) for phase rotation.
 - vi. Monitoring all phases of the normal service (Source 1) and emergency service (Source 2) for over voltage conditions (adjustable for dropout over a range of 105 to 135% of normal voltage, and pickup at 95-99% of dropout voltage level).
 - vii. Monitoring all phases of the normal service (Source 1) and emergency service (Source 2) for over or under frequency conditions.
- c. All transfer switch sensing shall be configurable from a Windows PC-based service tool, to allow setting of levels, and enabling or disabling of features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing DIP switches or other electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic LED lamps.
- d. The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature, and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature.
- e. Controls:
 - i. 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.
- ii. 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.
 - iii. 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.
 - iv. 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.
 - v. 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 cool down period prior to shut down (adjustable from 0 to 10 min).
 - vi. 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.
 - vii. The transfer switch operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred.
 - viii. 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:
 - (1) Source 1 OK
 - (2) 2-Wire Run
 - (3) Source 2 Ok
 - (4) Timing for Transfer
 - (5) Transfer Command
 - (6) Timing for Retransfer
 - (7) Retransfer Command
 - (8) Timing for Stop
 - ix. 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.
 - x. The control system shall be designed and prototype tested for operation in ambient temperatures from -40C to +70C. It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
 - xi. The control shall have optically isolated logic inputs, high isolation

transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.

4. CONTROL INTERFACE:

- a. The transfer switch will provide an isolated relay contact for starting a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C, for compatibility with any generator set.
- b. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 Amps, 250 VAC.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and National Electrical Code
- B. Ground all motor control centers in accordance with the National Electric Code and as specified in section 16450.
- C. Automatic transfer switches shall be mounted on 4" high concrete pads which shall extend 2" on exposed sides. Securely bolt each unit to its pad for proper horizontal and vertical alignment.
- D. Install Safety Labels in compliance with NEMA 260.
- E. All parameters for the transfer switch are required to be set up for proper operation when interfacing with the utility company and emergency power. Refer to document below for set up requirements. Set-up and configuration shall be submitted to the engineer with test data for record purposes.

3.2 TESTS

- A. Refer to Sections 16620 and 16950 for testing requirements.

STANDBY POWER SYSTEM
AUTOMATIC TRANSFER SWITCH SET-UP AND CONFIGURATION

Date: _____

Project: _____

Contractor: _____

Equipment Manufacturer: _____

Automatic Transfer Switch Model: _____

PARAMETERS

Parameter Description	Recommended Setting	Actual Setting
Time delay to override momentary normal source outages	*5 Seconds	
Adjustable time delay on retransfer to normal from emergency	*5 Minutes	
Time delay to stop emergency power upon re-transfer to normal source (generator cool down)	5 Minutes	
Time delay on transfer to emergency	*5 Seconds	

* Field coordinate time setting to obtain proper operation of equipment

This certifies that the Automatic Transfer Switch has been set up and configured as required to operate according to Section 16620.

(Authorized Representative of the Manufacturer)

(Date)

END OF SECTION

SECTION 16442PANELBOARDSPART 1 - GENERAL1.1 DESCRIPTION

- A. The work of this section includes the furnishing and installing of all panelboards as specified herein and as shown on the drawings. All panelboards shall be indoor type unless otherwise noted on the drawings.

1.2 QUALITY ASSURANCE

- A. The equipment specified herein is based upon the first manufacturer named after the phrase "Acceptable Manufacturer's". Equipment types, device ratings, dimensions, etc. correspond to the nomenclature dictated by that manufacturer. Equipment of other acceptable manufacturers shall be equivalent in every way to that of the equipment specified.
- B. Suppliers deemed equivalent shall be responsible to support and supply equivalent equipment which shall meet the intended design. Any extensive modifications or rework of the design drawings in order to facilitate acceptability shall be the responsibility of this Contractor at no additional cost to the Owner.
- C. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.
- D. Refer to equipment manufacturer requirements under 16010, Section 1.2.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit Shop Drawings for equipment as specified in section 16010.
- B. Refer to Section 01340 for shop drawing formatting requirements.

1.4 REFERENCE TO OTHER SECTIONS

- A. Refer to Section 16010 for identification nameplates requirements.
- B. Refer to Section 16010 for coordination, short circuit, and arc flash study requirements.
- C. Refer to Section 16450 for grounding requirements.
- D. Refer to Section 16950 for testing requirements.

PART 2 - PRODUCTS2.1 MATERIALS

- A. Panelboards - Lighting and Distribution 480Y/277 volt, 208Y/120 volt, 240/120 volt
 - 1. General
 - a. Panels identified for use as service entrance equipment shall be so labeled.
 - b. Panelboards shall comply with the applicable sections of UL, NEC and NEMA.
 - c. Acceptable manufactures are Squared D, Cutler-Hammer, General Electric or equal.

2. Interiors
 - a. Interior shall be completely factory assembled with bolt-on devices. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
 - b. Unless otherwise noted, full size insulated neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
 - c. Main bus bars shall be copper sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 50 degrees C above an ambient of 40 degrees C maximum.
 - d. A ground bus shall be included in all panels.
 - e. Main circuit breakers located within panelboards shall be center mounted, separate from the feeder section. Main circuit breakers installed as part of the feeder section are not acceptable.
3. Boxes
 - a. Boxes shall be at least 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.
 - b. Boxes shall be provided with removal blank ends.
4. Trims
 - a. Trims for lighting and appliance panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi-flush cylinder lock and catch assembly. Doors over 48 inches in height shall have auxiliary fasteners.
 - b. Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.
 - c. Surfaces of the trim assembly shall be properly cleaned, primed and a finish coat of gray ANSI 61 paint applied.
 - d. Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 of an inch on all sides.
 - e. A typed directory card with clear plastic cover shall be supplied mounted on the inside of each door.
 - f. Provide an engraved nameplate for each panel section.
5. Panelboard Ratings
 - a. Panelboards rated 240 VAC or less shall have short circuit ratings as shown on the drawings or as herein scheduled, but not less than 10,000 amperes rms symmetrical.
 - b. Panelboards rated 480 VAC shall have short circuit ratings as shown on the drawings or as herein scheduled, but not less than 14,000 amperes rms symmetrical.

- c. Breakers shall be a minimum of 100 ampere frame. Breakers 15 through 100 amperes trip size shall take up the same pole spacing.
- d. GFCI circuit breakers shall be a minimum of 100 ampere frame when indicated on the panelboard schedule. Breakers 15 through 100 amperes trip size shall take up the same pole spacing.
- e. Panelboards shall be labeled with a UL short circuit rating. When series ratings are applied with integral or remote upstream devices, a label shall be provided. Series ratings shall cover all trip ratings of installed frames. It shall state the conditions of the UL series ratings including:
 - i. Size and type of upstream device
 - ii. Branch devices that can be used
 - iii. UL series short circuit rating

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and National Electrical Code.
- B. All panelboards shall be installed so that the top circuit breaker handle is not higher than 6'-6" above finished floor.
- C. Panel shall be mounted to unistrut stainless steel framing channels. Panels shall not be hung directly off walls.
- D. Panels to be installed in finished areas shall be recessed with flush trim covers.
- E. Loads shall be balanced on all phases and branch circuiting rearranged, if balancing is required.
- F. All wiring connections shall be made in accordance per manufacturer's requirements.
- G. Install panelboards as shown on the Drawings.
- H. At each flush mounted panelboard, provide four (4) spare three-quarter inch (3/4) raceways from panel-board, etc. to an area above the nearest accessible ceiling space and floor space in the specific room location. Make 90 degree turn above the ceiling or below the floor and cap all conduits.
- I. Install panelboards in accordance with manufacturer's instructions.
- J. Install Safety Labels in compliance with NEMA 260.
- K. Ground all panelboard in accordance with the National Electric Code and as specified in section 16450.

3.2 TESTS

- A. Refer to Section 16950 for testing requirements.

END OF SECTION

SECTION 16461LOW VOLTAGE TRANSFORMERSPART 1 - GENERAL1.1 DESCRIPTION

- A. Furnish and install, single phase and three phase general purpose individually mounted dry-type transformers of the two-winding type, self-cooled, with ratings and voltages as shown on the contract drawings and indicated on the "Single Line Diagrams".

1.2 QUALITY ASSURANCE

- A. The equipment specified herein is based upon the first manufacturer named after the phrase "Acceptable Manufacturer's". Equipment types, device ratings, dimensions, etc. correspond to the nomenclature dictated by that manufacturer. Equipment of other acceptable manufacturers shall be equivalent in every way to that of the equipment specified.
- B. Suppliers deemed equivalent shall be responsible to support and supply equivalent equipment which shall meet the intended design. Any extensive modifications or rework of the design drawings in order to facilitate acceptability shall be the responsibility of this Contractor at no additional cost to the Owner.
- C. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.
- D. Transformers shall be designed, manufactured, and tested in accordance with all the latest applicable ANSI, NEMA, DOE, and IEEE standards.
- E. The following tests shall be made on all transformers:
 - 1. Ratio tests on the rated voltage connection and on all tap connections.
 - 2. Polarity and phase-relation tests on the rated voltage connection.
 - 3. Applied potential tests
 - 4. Induced potential test
- F. Refer to equipment manufacture requirements under 16010, Section 1.2.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit Shop Drawings for all service and distribution equipment, in their entirety, specified herein including the following information:
 - 1. Manufacturer and equipment type.
 - 2. Standard catalog information sheet.
 - 3. Detailed Shop Drawings indicating plan, elevation, end, and isometric views.
 - 4. Complete bill of materials.
 - 5. Additional information necessary to verify equipment to be supplied has features specified.
 - 6. Refer to Section 01340 for shop drawing formatting requirements.

1.4 REFERENCE TO OTHER SECTIONS

- A. Refer to Section 16010 for identification nameplates requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Dry Type Distribution Transformers (150 kVA and Below)

1. General

- a. Transformers shall be designed, manufactured, and tested in accordance with all the latest applicable ANSI, NEMA, DOE (Department of Energy), and IEEE standards.
- b. All 600 volt class transformers shall be UL listed and bear the UL label.
- c. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.
- d. Transformer efficiency shall meet or exceed the latest DOE 2016 Efficiency Standard requirements.

2. Insulation Systems

- a. Transformers shall be insulated as follows:

KVA	Insulation Class	Average Winding Temperature Rise (°C)	Maximum Ambient Temp. (°C)	Hot Spot Differential (°C)	Total Temperature Rise (°C)
≤ 2 KVA	F	80	40	15	150
3 KVA - 29 KVA	H	125	40	20	185
≥ 30 KVA	R	150	40	30	220

- b. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degree C maximum ambient, with a 30 degree C average ambient over 24 hours.
- c. All insulation material shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

3. Core and Coil Assemblies

- a. Transformer core shall be constructed with high grade, non-aging, grain-oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the highest tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade copper with continuous wound construction.
- b. On units rated below 30 kVA, the core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture-proof, shock resistant seal.
- c. On units rated 30 kVA and above, the core and coil assembly shall be impregnated with a non-hydroscopic, thermo-setting varnish and cured to reduce hot spots and seal out moisture.

4. Enclosures

- a. The enclosure shall be made of heavy gauge steel and shall be degreased, cleaned, primed, and finished with ANSI 61 color weather-resistant enamel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees C.
 - b. On units rated below 15 kVA, the enclosure construction shall be totally enclosed, non-ventilated, NEMA 3R, with lifting eyes.
 - c. On units rated 15 kVA and above, the enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting holes. All ventilation openings shall be protected against falling dirt. On outdoor units, provide suitable weather shields over ventilation openings.
5. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self cooled ratings:

KVA Rating	Maximum Sound Ratings
Up to 9 KVA	40 dB
10 to 50 KVA	45 dB
51 to 150 KVA	50 dB

6. Nameplates: Provide 1 inch high x 3 inches engraved lamocoid nameplates for each transformer. Furnish white letters on a black background. Identify primary and secondary voltages and feeder source designation on the nameplate.
7. Terminations: All lugs shall be UL Listed to accept solid and/or stranded copper and aluminum conductor. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating in the NEC. Provide required number of lugs/phase as indicated by the contract drawings and cabling requirements.
8. Manufacturers
9. Transformers shall be manufactured by Square D, Cutler-Hammer, General Electric, Hevi-Duty, Acme or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and National Electrical Code.
- B. Ground all transformers in accordance with the National Electric Code and Section 16450.
- C. Floor mounted dry-type transformers shall be mounted on 4" high concrete pads which shall extend 2" on exposed sides.
- D. Install dry-type transformers with adequate clearances for proper ventilation.
- E. Bolt floor mounted transformer to concrete pad utilizing neoprene vibration damping pads. Securely bolt each unit to its pad for proper horizontal and vertical alignment. Use shims where necessary.
- F. Install Safety Labels in compliance with NEMA 260.

3.2 TESTS

A. Refer to Section 16950 for testing requirements.

END OF SECTION

SECTION 16469VARIABLE FREQUENCY DRIVESPART 1 - GENERAL1.1 DESCRIPTION

- A. Provide all variable frequency drives (VFD) as indicated on the "Single Line Diagram". Contractor shall coordinate variable frequency drive manufacturer selection with all equipment manufacturers.
- B. Contractor shall coordinate variable frequency drive manufacturer selection with all equipment manufacturers and shall be solely responsible for ensuring that the individual variable frequency drives furnished are completely compatible with all requirements and intended functions of the driven equipment. The basis for design for this project is based on Allen-Bradley.
- C. This is a specific application requiring single to three phase conversions through the specified VFD equipment.
- D. Acceptable manufacturers are Allen-Bradley, Square D, Toshiba, or equal.

1.2 QUALITY ASSURANCE

- A. The equipment specified herein is based upon the first manufacturer named after the phrase "Acceptable Manufacturer's". Equipment types, device ratings, dimensions, etc. correspond to the nomenclature dictated by that manufacturer. Equipment of other acceptable manufacturers shall be equivalent in every way to that of the equipment specified.
- B. Suppliers deemed equivalent shall be responsible to support and supply equivalent equipment which shall meet the intended design. Any extensive modifications or rework of the design drawings in order to facilitate acceptability shall be the responsibility of this Contractor at no additional cost to the Owner.
- C. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

1.3 REFERENCES

- A. Institute of Electrical and Electronic Engineers (IEEE)
 - 1. Standard 519-1992 2014, IEEE Guide for Harmonic Content and Control
- B. Underwriters Laboratories
 - 1. UL508C
- C. National Electrical Manufacturer's Association (NEMA)
 - 1. ICS 7.0, AC Adjustable Speed Drives

1.4 SUBMITTALS TO THE ENGINEER

- A. Submit Shop Drawings for all service and distribution equipment, in their entirety, specified herein including the following information:
 - 1. Manufacturer and equipment type.
 - 2. Standard catalog information sheet.
 - 3. Detailed Shop Drawings indicating plan, elevation, end, and isometric views.

4. Customized schematic wiring diagrams are required as these are not standard VFD equipment. Failure to provide customized schematic wiring diagrams shall be grounds for automatic rejection of this equipment.
5. Complete bill of materials.
6. Additional information necessary to verify equipment to be supplied has features specified.
7. Refer to Section 01340 for shop drawing formatting requirements.

1.5 REFERENCES TO OTHER SECTIONS

- A. Refer to Section 16010 for identification nameplates requirements.
- B. Refer to Section 16010 for coordination, short circuit, and arc flash study requirements.
- C. Refer to Section 16900 for control device requirements.
- D. Refer to Section 16160 for Cabinet and Enclosures.
- E. Refer Division 13 for Seismic Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Variable Frequency Drives (VFD's)
 1. The drive shall be capable of varying the speed of a standard or inverter duty rated NEMA Design B induction motor from a virtual standstill to the standard speed of the motor. The unit shall transform input power into a variable voltage, adjustable frequency three phase output of suitable capacity and waveform.
 2. Input voltage shall be as indicated on the Drawings and/or as specified in the equipment specification sections. Frequency shall be 60 Hz.
 3. Output shall be three (3) phase voltage as indicated on the Drawings and/or as specified in the equipment specification sections.
 4. The drive shall be a PWM (Pulse Width Modulated) transistorized inverter.
 5. The drive manufacturer shall have not less than five years of experience in the manufacture of drives in the United States.
 6. Enclosure type shall be as required for the specific application as shown on the Drawings and/or as specified in the equipment specification sections.
 7. The drives shall be rated for constant or variable torque applications (460V - 1 HP to 150 HP), depending on the individual driven load requirements. For constant torque applications, the output transistors shall be low-gain, fully rated. Derated high-gain transistors are not acceptable.
 8. Power Line Considerations
 - a. Each VFD or multiple sets of VFD's shall be designed and installed such that: the total harmonic distortion reflected back to the power source is a maximum of 5%, the notch depth reflected back to the power source is a maximum of 20%, and the notch area reflected back to the power source is a maximum of 22,800 volt-microseconds. The total harmonic distortion, notch depth and notch area shall be as defined by IEEE-519-2014.
 - b. Line reactors and other required devices shall be provided for individual VFD's where indicated on the Drawings and/or in the VFD schedule.

9. Enclosures
 - a. Unless otherwise noted in drive schedule, all variable frequency drives and all associated equipment and control devices shall be located within their respective single, inclusive, enclosure as shown on the Drawings. Separately submitted and mounted devices will not be accepted.
 - b. Refer to schematic diagrams and VFD schedule for further information.
10. Filtering
 - a. RFI/EMI filters shall be provided by supplier and shall be rated for, and compatible with, each VFD. They shall function as a complete system. Additional line reactors beyond those shown on drawings may be required in order to comply with the above parameters.
 - b. 5% line reactors shall be mounted inside the respective VFD enclosure reactors and shall be TCI Harmonic Guard or equivalent.
 - c. Harmonic matrix filters and switching capacitor shall be provided where shown on drawings. Refer to single line diagrams and schematics for additional information.
11. System Analysis
 - a. 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:
 - i. A brief summary of the equations and calculation procedures used in the study.
 - ii. 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.
 - iii. 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.
 - iv. Detailed list of the amplitude of harmonic currents and voltages to the 50th harmonic.
 - b. 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:
 - i. 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.
 - ii. 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 (X_d), Power factor, kW, X/R Ratio.
- iii. 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.
12. Ambient Conditions
 - a. Environment - Indoors, NEMA rating to match areas as depicted on the NEMA CLASSIFICATION SCHEDULE on Drawing E-1.
 - b. Ambient Temperature - 10 degrees C to 40 degrees C
 - c. Altitude - Less than 3,300 feet
 - d. Relative humidity - 90% maximum
 - e. Vibration - less than .5G
 13. Control System
 - a. Input power:
 - i. Main circuit: 240V/60Hz, single phase input or as shown on drawings
 - ii. Control circuit: no external power for input shall be required.
 - iii. Single phase to three phase conversions.
 - b. Tolerance: Voltage + 10%. Frequency + 2 Hz.
 - c. Control method: Sinusoidal PWM control
 - d. Output Voltage: 3PHASE, 240 Volt.
 - e. Output Frequency: 0.01 Hz to 60 Hz
 - f. Frequency resolution: 0.01 Hz Operating panel input; 0.03 Hz Analog input; 0.01 Hz Computer interface input
 - g. Frequency accuracy: + 0.5% of max frequency at 25 deg. C + 10 deg.C
 - h. Volts/Hz characteristics:
 - i. Either constant V/f or variable V/f (user selectable)
 - ii. Base frequency adjustable from 25 Hz to 60 Hz
 - iii. Voltage boost adjustable from 0% to 30%
 - iv. Starting frequency adjustable from 0 Hz to 10 Hz
 - i. Overload current: 150% for 1 minute (constant torque applications).
 - j. Frequency command signal: 3k Potentiometer 0-10 VDC; 0-5 VDC; 4-20 mA
 - k. Frequency jump - 3-point settings: Setting jump frequency (0 to Max frequency), and width (0 to max frequency).
 - l. Upper/lower limit frequencies: Upper limit 0 to Max frequency. Lower limit 0 to upper limit.
 - m. PWM carrier frequency: Adjustable from 400Hz to 2000Hz.
 14. The drive shall provide a minimum displacement power factor of 0.95 throughout the speed range.
 15. Minimum lead length to motors for VFD drive without requiring an additional output filter shall be 250 feet.
 16. The efficiency of the drive at full speed shall be a minimum of 98 percent.

17. The drive shall be provided with an MCP type circuit breaker to serve as a disconnect and coordinated with the drive protective features for the motor to form a complete combination type starter/controller. If necessary, the drive shall also be provided with current limiting fuses on the input side of the drive, sized and rated as required by the drive manufacturer, so that the drive is rated for the available fault current.
18. The drive shall contain relays, push buttons, timers, and all other appurtenances necessary for the specific application as specified in the equipment specification sections, and as shown on the Electrical and Instrumentation Drawings.
19. Operational Functions:
 - a. Acceleration/deceleration times: 0.1 to 600 seconds, 2 separate acceleration and deceleration times.
 - b. Forward or reverse run can be chosen.
 - c. Jogging
 - i. Running - 0 to 20 Hz
 - ii. Braking - Deceleration, DC injection, or coasting
 - d. Multispeed run: up to 7 preset speeds can be chosen.
 - e. VFD shall be capable of accepting a 4-20 mA input signal and adjusting speed accordingly.
 - f. Automatic Restart: Recovers a normal run of a coast-stopping motor.
 - g. Soft Stall: Sustains a run in overload mode. (90% - 150% adjustable)
 - h. Overload: Adjustable from 60 - 100%
 - i. Complete adjustment of parameters gives thousands of volt/frequency patterns.
20. Protective Features:
 - a. Functions individually identified by 18 fault codes:
 - Overcurrent during acceleration (OC1)
 - Overcurrent during deceleration (OC2)
 - Overcurrent during run (OC3)
 - Overcurrent detected at start-up (OCA)
 - Short circuit at load (OCL)
 - Overcurrent in regenerative discharge resistor (OCr)
 - Overvoltage during deceleration (OP2)
 - Overvoltage (OP)
 - Overload (OL)
 - Overload of regenerative discharge resistor (OLr)
 - Overhead (OH)
 - Ground Fault (EF)
 - Emergency Stop (E)
 - Frequency Setting Signal Abnormality (Err.1)
 - EE Prom abnormality (EEP, EEP2, EEP3)
 - Computer link abnormality (Err.t)
 - b. Drive shall have an external fault trip input terminal.
 - c. Drive shall reset when a designated contact is closed on the terminal strip.

21. Monitor Functions
 - a. The drive shall have display scaler of monitoring frequency. (Range 0.10 to 200)
 - b. The drive shall be able to monitor different parameters.
 - c. The drive shall have an LED on the front panel showing that the main DC circuit capacitor is charged.
22. Controller
 - a. All parameters should be adjustable from the keypad.
 - b. One key shall toggle between panel control and terminal control.
 - c. The drive shall have a reset to factory settings.
 - d. The keypad shall match enclosure NEMA rating.
 - e. The keypad shall allow for parameters to be changed while drive is running.
 - f. Most common used parameters should be labeled on the keypad.
23. Schematic Diagram
 - a. Refer to the contract drawings for customized VFD configuration.
24. All models shall be UL listed.
25. The drive shall be provided with thermal overload function.
26. The drive shall be provided with auxiliary run contact to indicate running status.
27. Variable frequency drive vendor must be a local distributor which has factory-trained personnel and warranty authorization; capable of testing unit(s) with motor loads.
28. Variable Frequency Drive Schedule:

Equipment Name	HP	Constant or Variable Torque	Harmonic Traps/Line Reactors/ RFI/EMI/ dv/dt long lead filters	Supplier	Notes
Submersible Pump No.1	15	30 HP CT VFD	Line Reactors/ RFI/EMI/Harmonic Matrix Filter	Electrical Contractor	See Note 1
Submersible Pump No.2	15	30 HP CT VFD	Line Reactors/ RFI/EMI/Harmonic Matrix Filter	Electrical Contractor	See Note 1

Note 1: Provide an oversized drive as required to convert a single-phase input to a 3-phase output as determined by the manufacturer. Motor horsepower is 15 HP and a 30 HP constant torque (CT) VFD shall be supplied for each submersible motor. See additional requirements and sizing.

29. Provide a complete VFD system and a customized and modified control panel for each pump motor installation. Refer to schematic diagram on the Contract Drawings for additional requirements.
30. Provide each of the VFD control panels with the following:

- a. Single to three phase conversion application.
- b. Single VFD NEMA rated as depicted on NEMA CLASSIFICATION SCHEDULE ON E-1 which shall be NEMA 12, vented type enclosure control panel for each submersible pump. No separately mounted devices and equipment outside of this enclosure.
- c. Line reactor 5%, harmonic matrix filter, RFI/EMI filter, as specified and as shown. Provide a matrix harmonic filter and separate switching contactor for capacitor portion of filter as shown.
- d. Through the door disconnect operator pad lockable in the off position.
- e. Front panel mounted keypad, run light, elapsed time meter and all specified items and as shown on the drawings.
- f. The application shall provide for a 240, 1 phase input to each of the two (2) respective VFD control panels shall be based on motor ampacity and not strictly HP rating. The VFD drive is to convert the input power to a 3-phase output to operate the motors.
- g. The following information is being supplied for Submersible Pumps No.1 and No.2
 - Motor Horsepower = 15 HP
 - Full Load Current = 37.0 Ampere at 230 volts, 3-phase.
 - Maximum Full Load Current at Service Factor = 48.1 Ampere
 - Locked Rotor Current = 222 Ampere
- h. The final sizing of all VFD equipment shall be based on the following criteria:
 - 110% continuous output current.
 - 150% overload current for 2 minutes.
 - The final VFD sizing shall be based upon the specified 30 HP constant torque VFD and the current output requirements set forth for the respective motor and application. Provide the sizing for greater of the two (2) current output requirements.
- i. Provide three (3), 8 hour days of start-up and training for commissioning and final acceptance of this VFD equipment. All equipment must be pre-started, testing and certified ready for testing prior to any of these days being used. Provide a two week written schedule ahead of time to the Engineer and Owner to schedule final start-up and testing as well as training. Training will not be held the same day as start-up and shall be scheduled only upon start-up completion and acceptance.
- j. VFD shall be calibrated to the input signal based upon minimum and maximum flow settings.
- k. Provide VFD Parameter Setup and Verification. See Part 3 of this specification.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and National Electrical Code

- B. Ground all motor control centers in accordance with the National Electric Code and as specified in section 16450.
- C. Freestanding variable frequency control panels shall be mounted on 4" high concrete pads which shall extend 2" on exposed sides. Securely bolt each unit to its pad for proper horizontal and vertical alignment. Use shims where necessary.
- D. Ground all motor frames (operating on Variable Frequency Drives) and VFD shielded cable per the recommendations of the manufacturer of the Variable Frequency Drive.
- E. Install Safety Labels in compliance with NEMA 260.
- F. Inspect all bus bolts prior to energization to check for looseness developed during shipment or handling.
- G. Refer to Section 16050 for equipment mounting heights and meet all requirements of the latest addition of the NEC.

3.2 TESTS

- A. Refer to Section 16950 for testing requirements.
- B. VFD Start-Up, Testing and Parameter Setup and Verification
 1. Responsibility and Coordination: The VFD supplier/electrical subcontractor is 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/electrical subcontractor is 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 supplier and the specifying engineer. This meeting shall take place prior to the initial startup of the equipment.

VFD PARAMETER SETUP CHECKLIST

CIDER MILL PUMP STATION

- 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

CIDER MILL PUMP STATION

Date: _____

General Contractor: _____

Electrical Subcontractor: _____

VFD Supplier: _____

This certifies that the VFD parameters have been coordinated per the specifications and the requirements of Section 16469.

_____	_____
(Authorized Representative of the General Contractor)	Date
_____	_____
(Authorized Representative of the Electrical Subcontractor)	Date
_____	_____
(Authorized Representative of the VFD Supplier)	Date

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. 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, 16010 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 16010 "Electrical - General" for this requirement.

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. Acceptable manufactures are Cooper, Lithonia, or equal.
- B. Emergency Lighting System (12 VDC System)
 1. Power Units
 - a. Dry and 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 a glare-free, 8 watt, PAR 36, sealed halogen lamp.
- x. Remote heads shall be flame and impact resistant thermoplastic lampholders suitable for use in wet locations.
- xi. Lamps shall be 12 volt, 8 watt halogen sealed beam.
- b. 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 and 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 120V 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.
- b. 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 120 volt, 60 watt, clear 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.
- C. Exterior Lighting Control Panels (ELCP)
- 1. The control panel shall operate on 120 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.
 - 9. The control panel shall be provided with a top center mounted lamacoid nameplate, key lockable L shaped handle kit and shall have no side or front mounted mechanical clips for entry or closure of the enclosure.
- D. 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. Install Exterior Lighting Control Panel at an accessible height for convenient access and operation.

3.2 TESTING

- A. Refer to Section 16950 for testing requirements.

END OF SECTION

SECTION 16620DIESEL STANDBY POWER SYSTEMPART 1 - GENERAL1.1 DESCRIPTION

- A. Provide a complete standby power system as indicated in the Contract Documents. The system shall be a factory built, prototype tested, production tested, field tested, complete and operable emergency / standby electric generating system, including all devices and equipment specified herein, shown on the Drawings, and/or as required for the service. Materials and equipment shall be new and current, delivered to the site completely wired, tested, and ready for installation. This system shall include the following:
1. An indoor diesel engine driven electric plant with an integrated and mounted belly fuel tank to provide standby electric power.
 2. Engine-generator control console resiliently mounted on each generating set shall include complete engine start-stop control and monitoring system.
 3. Starting batteries with battery charger for each engine-generator set.
 4. Automatic load transfer controls are to be provided by the generator equipment supplier. The Refer to section 16415 for additional information.
 5. Mount any and all loose accessories, control devices, and other equipment as specified herein and/or as shown on Drawings.
 6. Such other components, accessories, parts, tests, documents, and services, as needed to meet the performance requirements of this specification.
 7. All necessary interconnecting wiring and connections to provide proper system operation.
 8. Field testing, start up, and automatic transfer switch parameter set up as specified in Section 3 of this section.
- B. This equipment, including engine-generator sets shall be manufactured by a single manufacturer who has been regularly engaged in the production of engine-generator sets for a minimum of ten years.
1. The electric generating system described herein, including these components shall be factory built, factory tested, and shipped by this single manufacturer, so there is one source of supply and responsibility for warranty, parts, and service. This manufacturer shall have a representative based 150 miles who can provide factory trained servicemen on a 24-hour per day basis, required stock of replacement parts, and technical assistance.
 2. Different manufacturers for the engine-generator set and the automatic load transfer controls will be acceptable providing that the equipment is completely coordinated, reviewed, integrated and written verification is provided that this system equipment is completely compatible before shipment and the engine-generator set manufacturer is the source of responsibility for a complete and operational system interface between this equipment.
 3. The responsibility for performance to this specification in its entirety cannot be split up among individual suppliers of components comprising the system, but

- must be assumed solely by the supplier of the system. The manufacturer shall furnish schematic and wiring diagrams for the engine-generator set(s).
4. All controls shall be the standard of the manufacturer, who is engaged in the manufacture of generators and has them available for sale on the open market. Control parts shall be identified by part numbers of this manufacturer and shall have second source listing where applicable. Control systems that are supplied by a sub-vendor or subcontractor of the vendor and not incorporated within the documentation drawings of the generator manufacturer are not acceptable.
 5. Complete load bank, building load testing, sound level testing and system equipment checkout will be required to be performed as part of the overall acceptance of this equipment.
- C. The work of this section shall also include the overall supervision, start-up and testing of an owner-furnished, existing, diesel-fueled, emergency standby generator. The responsibility of the generator manufacturer is to provide services and oversight for re-connection of the existing generator for the intended application as outlined within the guidelines of the contract documents. Refer to specific requirements noted under this section of the work.

1.2 QUALITY ASSURANCE

- A. The electric generating system must meet all requirements of NFPA 110 (Level 2) including design specifications, prototype tests, one-step full-load pickup, and installation acceptance.
- B. The performance of the electric plant shall be certified by the manufacturer verifying the electric plant's full power rating, stability and voltage and frequency regulation.
- C. The complete standby power system installation, start-up and operating instructions shall be performed under the supervision of a factory-trained engineer/representative of the system manufacturer.
- D. Acceptable Manufacturers:
 1. Electric Plant:
 - a. Cummins Power Generation
 - b. Caterpillar
 - c. Or equal
 2. Automatic Load Transfer Controls:
 - a. Specified under Section 16415. Refer to this related section for additional requirements.
 3. Equipment as described herein is that as manufactured by Cummins, and all equipment furnished shall be equal in every way to that specified herein, including quality, operation, and function.
 4. The equipment spacing, mounts, electrical wiring, ventilation equipment, fuel and exhaust components have all been sized and designed around the manufacturers listed. If alternate equipment is substituted, the contractor shall be responsible for changes in the facilities work, made necessary from installation of equipment other than Cummins, without additional cost to the Owner, and shall verify all work with the equipment manufacturer.
 - a. Any bidder wishing to use substitute equipment shall submit detailed data to the Engineer. Complete shop drawings, diagrams, and details shall be prepared specifically for this project. Standard and typical drawings will

not be acceptable. Data for substitute equipment shall include complete information for the following:

- i. Plan drawing to verify that substitute equipment will fit into space allocated and allow for removal and service.
 - ii. Allowance for proper cooling and combustion air.
 - iii. To verify that all interconnecting wiring and piping is accounted for, provide complete interconnecting wiring diagrams and piping diagrams.
 - iv. Provide the results of engineering to show compliance with the requirements for "prototype testing".
 - v. Complete load study and load profile to show that engine-generator set(s) will not be overloaded during any phase of operation, including motor starting and steady-state load conditions.
 - vi. Specification information, factory literature, catalog sheets, etc., to show compliance with specifications.
 - vii. Deductions or additions to contract price for use of proposed substitute equipment.
 - viii. Complete list of deviations from these specifications.
 - ix. Short circuit study of the load circuits to verify that selective coordination and thermal and magnetic stresses on components will be equal to that specified.
 - x. List of projects using similar equipment for the last 5 years.
 - xi. Subtransient reactance listed.
 - xii. Integration of the below mounted integral belly fuel tank and all piping, ventilation and connection requirements. Also, all generator equipment mounting heights and access limited to the requirements as noted in the NEC. The generator supplier is responsible to limit the height of the assembly of the generator and integral belly fuel tank as a system requirement and maintain and provide equipment which meets NEC height requirements.
- E. Service:
1. Replacement parts and competent service shall be available within the New England states.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submittals shall be provided in accordance with Sections 01340, 16010 and as specified in this section.
1. Complete typewritten description of system operation(s), and ratings, including a listing of all auxiliary devices.
 2. Manufacturer's data sheets and detailed dimensioned drawings for all pieces of equipment and auxiliary devices.
 3. Complete interconnecting wiring diagrams, cross referenced with equipment designations indicated in the Contract Documents, indicating all required wiring between the electric plant control panel, the automatic load transfer controls and all auxiliary devices.

4. Independent testing laboratory reports indicating the performance test results of the electric plants including power rating, stability and voltage and frequency regulation.
5. Unless specified otherwise herein, all performance data and other information shall be as on the manufacturer's printed literature. Performance data shall be the result of test procedures in accordance with nationally recognized standards, plus such other procedures that are judged necessary by the manufacturer to insure maximum service reliability for emergency systems, and shall be available for inspection by the Engineer upon request.
6. Equipment supplier shall submit complete detailed step load program and calculations as part of the shop drawing submittal to demonstrate compliance with the motor starting and performance criteria as specified elsewhere in this Section.
7. All testing data sheets for load bank testing results, building load testing and sound level testing shall be submitted for final acceptance.
8. The supplier shall submit an engineered product for the specific application noted herein. Therefore, if the load equipment consists of a non-linear type application the supplier is required to perform a harmonic analysis of the generator determining both current and voltage distortion levels along with total harmonic distortion (THD) for the system based on the step loads assigned under this Section.
9. Layout plans and wiring diagrams of day tank and components of fuel transfer and delivery and pumping systems. Also all generator and tank assembly drawings as an integral assembly or submittals will be rejected.

1.4 TESTING

- A. The intent of this specification is to provide equipment of proven reliability and compatibility. Three separate series of tests shall be performed: Factory Prototype Model Tests, Factory Production Model Tests, and Field Tests.
 1. Factory Prototype Model Tests: The electric generating system consisting of prime mover, generator, governor, coupling and all controls must have been tested as complete unit on representative engineering prototype model as required by NFPA 110. The tests, being potentially damaging to the equipment tested, must not be performed on equipment to be sold, but on separate prototype models as specified by NFPA 110, paragraph 3-2.1 thru 3-2.1.2 and their accomplishment certified by means of documentation of the tests accompanying submittal data. These tests shall have included:
 - a. Maximum power level (maximum kW).
 - b. Maximum motor starting capacity (maximum KVA) and voltage dip recovery within seven (7) cycles of applied load.
 - c. Structural soundness (Short-Circuit and Endurance Tests).
 - d. Torsiograph Analysis: The manufacturer of the engine-generator set shall verify that the engine-generator combination, as configured, is free from harmful torsional stresses. The analysis shall include correlation of empirical data from tests on a representative prototype unit. The empirical data must include spectrum analysis of the torsional transducer output within the critical speed range of the engine-generator set. Results of this

- analysis shall be made available to the specifier on request. Calculations based on engine and generator separately are not acceptable.
- e. Engine-generator cooling and combustion air requirements.
 - f. Transient response and steady-state speed control and voltage regulation.
 - g. Generator temperature rise per NEMA MG1-22.40.
 - h. Harmonic analysis and voltage waveform deviation per MIL-STD-705B, method 601.4 and as specified and required under this section. Refer to previously noted requirements.
 - i. Three-phase short-circuit test for mechanical and electrical strength. With system operating at rated volts, amps, power factor, and speed, the generator terminals must be short circuited ten times on all three phases for a duration of thirty seconds. Engine-generator set must build up and perform normally without manual interventions of any kind such as resetting of circuit breakers or other tripping devices when the short circuit is removed.
 - j. Failure mode test for voltage regulator. With engine-generator set operating at no load, rated speed and voltage, the AC sensing circuit to the regulator must be disconnected for a period of at least one hour. The engine-generator set must be fully operative after the test, and without evidence of damage.
 - k. Endurance testing is required to detect and correct potential electrical and mechanical problems associated with typical operation.
2. Factory Production Model Tests: Before shipment of the equipment, the engine-generator set(s) shall be tested under rated load and power factor for performance and proper functioning of control and interfacing circuits. Testing at unity power factor only (resistance banks only) is not acceptable, since kW output is affected by the higher generator efficiency at unity power factor, and the KVAR for motor starting and regulation loads varies with power factor. Tests shall include:
- a. Single step load pickup per NFPA 110, paragraph 5-13.2.6.
 - b. Transient and voltage dip responses and steady state voltage and speed (frequency) checks.
- A summary of these test results shall be submitted a minimum of one month before the date of substantial completion.

1.5 LOADS AND REQUIREMENTS

- A. The specific loads and requirements have been provided for the generator starting, running and shutdown requirements. Therefore, all responsibility for proper operation and regulation shall be provided by the supplier of this equipment. If this is not completely understood or included for the performance of this equipment then it shall be grounds for rejection of this equipment. The submittal requirements have been specifically noted in order to avoid any possible issues regarding improper operation of the standby power system. It shall be clearly understood and noted that the supplier will be responsible to provide all documentation and requirements set forth under this section for review and approval.
- B. This is a specific application design which requires a single-phase generator operating a three-phase motor load which is converted via a variable frequency drive. This is a

single to three phase conversion application which needs to be understood. Refer to the drawings for additional requirements.

1.6 WARRANTY

A. The complete standby electric power system, including 1800 r/min engine-generator set shall be warranted for a period of five (5) years or fifteen hundred (1,500) operating hours, whichever occurs first, from the date of Substantial Completion. Multiple warranties for individual components (engine, generator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. This warranty shall be detailed in available written documents. In the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. This system shall include an engine-generator set at each site meeting or exceeding the minimum ratings as tabulated below, on a continuous standby basis. The sizing and selection of the specified generator has been based upon the specific manufacturer based upon the software design of this product.

Maximum Allowable Starting Voltage Dip	Maximum Allowable Peak Voltage Dip	Maximum Allowable Freq. Dip	Maximum Surge kW Capability	Maximum Surge kVA Capability
20%	20%	10%	Per Manufacturer	Per Manufacturer

KW	KVA	Power Factor	Hz	Volts	Phase/Wire
60	75	0.8	60	240/120	Single Phase 3 Wire

2. The engine generator set shall be capable of reliably starting the connected loads in the order listed in the table below. This shall be accomplished without exceeding the voltage and frequency dip specifications, and without causing unacceptable operation of electrical equipment. These load steps shall be coordinated with the Division 13 Integrator for proper staging of loads upon a power loss. This application shall be based upon a phase conversion of the motor load via a variable frequency drive equipment installation.

Load Name:	Load Rating (HP / kVA)	Starting Method
<i>Step 1:</i>		
Base Load 1	8 KVA	Light + Miscellaneous Load
Base Load 2	9 KW	Heat Load
<i>Step 2:</i>		

Submersible Pump No. 1 or 2	15 HP	VFD PWM (See Note 1)
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FVNR = Across the Line

VFD PWM = Variable Frequency Drive, Pulse-Width-Modulated with phase conversion application.

RVSS = Reduced Voltage Solid State Starters

Note 1:

1. Only one of the two pumps can be operated as the step 2 load.

3. The Standby Power System supplier shall have a complete understanding of the loads to be started and operated on emergency power, and the generator shall be properly sized and configured to perform the intended function.
4. Each engine-generator set shall be mounted on a heavy-duty steel base to maintain proper alignment between components, and each set shall incorporate vibration isolators of the type and quantity as specified by the set manufacturer, whether mounted internally or externally to the set.
5. The total loading on the standby generator shall not exceed 80%. Any submitted generator program submitted which does not meet with this requirement are terms for automatic rejection based on discretion of the Engineer

B. Engine:

1. Each engine shall be certified to U.S. EPA Emergency Only Use Emission regulations at the time of installation/commissioning in the state where being installed.
2. Engine shall be liquid-cooled, diesel for use with ultra low sulfur diesel fuel. Design shall be turbocharged and intercooled where required by engine manufacturer.
3. Engine shall be certified by the engine manufacturer as capable of driving a generator yielding a kW rating as specified herein. Engine shall be capable of driving the generator of this rating on a continuous standby basis for the duration of normal utility source interruptions per SAE J1349 conditions.
4. Fuel injection and valves shall not require adjustment while in service.
5. Maximum ambient air temperature 122°C .
6. Engine equipment shall include the following:
 - a. An electric starter(s) as required by the manufacturer.
 - b. Positive displacement, mechanical full pressure lubrication oil pump, full flow lubrication oil filters with replaceable elements and dipstick oil level indicator.
 - c. Fuel filter with replaceable element, and an engine driven, mechanical positive displacement fuel pump, all mounted on the engine. Replaceable dry element air cleaner.
 - d. Engine speed isochronous electronic governing system to control generator frequency within $\pm 0.25\%$ of rated frequency under steady state load conditions, and capable of parallel operation with load sharing controls.
 - e. Engine protection devices shall have sensing elements located on the engine to initiate the following preliminary alarms and engine shutdowns:
 - i. Low coolant temperature alarm

- ii. Low lubrication oil pressure alarm
 - iii. High coolant temperature alarm
 - iv. Low lubrication oil pressure shutdown
 - v. High coolant temperature shutdown
 - vi. Overspeed shutdown
 - vii. Overcrank lockout
 - viii. Low coolant level shutdown
 - ix. Output normally closed dry contact which opens when generator runs and stays open as long as generator operates for ventilation requirements. See drawings for details.
- f. Engine starter battery charging alternator with solid-state voltage regulator.
 - g. Engine mounted thermostatically controlled water jacket heater(s) for engine to aid in quick starting. Heater(s) shall be rated 1500 W, 120V, single phase, 60 HZ, or as recommend by the manufacturer for the proper sizing and requirements of this unit.
7. Cooling System:
- a. Engine shall be radiator cooled by engine mounted radiator system including belt-driven pusher fan, coolant pump, coolant level sensor, and thermostat temperature control. Performance of components shall be as required by set manufacturer.
 - b. Radiators shall be provided with a duct adapter flange permitting the attachment of air discharge duct directing the discharge of radiator air through the wall.
 - c. The cooling system shall be sized to operate at full load conditions and 120°F ambient air entering the room.
8. Engine Exhaust System:
- a. Exhaust muffler shall be provided for each engine of size as recommended by the set manufacturer. Muffler shall be of the side inlet, end outlet type and critical grade type. Provide support for the muffler so its weight is not supported by the engine.
 - b. Stainless steel flexible exhaust connection shall be provided as required for connection between engine exhaust manifold and exhaust line, in compliance with applicable codes and regulations.
 - c. All components shall be properly sized to assure proper operation without excessive back pressure when installed as shown on drawings.
 - d. Provide guards or insulation as required by UL2200 at all "hot" locations of the generator including exhaust manifolds, flexible connections, etc., for a complete installation. Where not recommended or required for this application, the supplier is required to meet all safety and protective requirements of this section for alternative methods.
 - e. Exhaust system shall be insulated and installed as specified in Division 15.
9. Diesel Fuel System:
- a. Provide a sub-base fuel tank with level gauge. The tank shall be new, unused, and shall not be galvanized. Tank shall be UL listed for secondary

containment, dual wall, with rupture basin switch. The manufacturer shall size the tank to provide a minimum of 48 hours of operation based on 75% loading or actual loading of the generator, whichever is larger.

- b. The tank is to be a customized tank built such that the footprint of the fuel tank does not exceed the frame of the generator in any direction.
- c. A low fuel supply sensing device shall be installed on the fuel tank for monitoring a low fuel level and also for sending a low-level alarm.
- d. The fuel tank shall be provided with a fuel fill line with lockable cap, and a 2-inch exterior vent line with approved vent cap. The vent line, etc. shall be located outside the building to meet local code requirements and approval. Fuel fill line shall be located inside of the building. Provide complete details along with fuel tank drawings and assembly.
- e. If the height of the generator equipment exceeds NEC requirements due to below mounted tank the contractor is required to provide a code compliant platform, step-up and aluminum railing and all necessary equipment to meet tank requirements. Therefore it is important that this requirement be completely understood and met for an acceptable installation.

C. Generator

1. Generator shall be single-bearing, 2/3rd pitch, self-aligning, four-pole, synchronous type, revolving field, with amortisseur windings, with direct drive centrifugal blower for proper cooling and minimum noise, with temperature compensated solid-state voltage regulator, with brushless PMG exciter system. No brushes will be allowed. Telephone influence factor less than 50 per NEMA MG1-22.43.
2. Generator shall be directly connected to engine flywheel housing and driven through a flexible coupling to insure permanent alignment; gear driven generators are not acceptable under this specification.
3. Gear reducers are not acceptable. Maximum speed of generator shall be 1800 RPM.
4. Insulation shall meet NEMA standards for Class H and additionally shall meet the Quality Assurance requirements of paragraph 4 of the Cummins Power Generation "PTS" certificate.
5. The maximum alternator temperature rise shall not exceed 105 °C above ambient. Generator design shall prevent potentially damaging shaft currents.
6. The three-phase, broad range, reconnectable generator shall have 12 leads brought out to allow connection by user to obtain any of the available voltages for the unit.
7. Voltage regulator shall be solid-state design and shall function by controlling the exciter magnetic field between stator and rotor to provide no load to full load regulation of rated voltage within $\pm 1\%$ during steady-state conditions.
 - a. The engine-generator set and regulator must sustain at least 90% of no load voltage for ten (10) seconds with 250 % of rated load at near zero power factor connected to its terminals.
 - b. The voltage regulator shall be insensitive to severe load induced waveshape distortion from SCR or thyrister circuits such as those used in

- battery charging (UPS), solid state reduced voltage starting, surge control applications, variable frequency drives (VFD's), and motor speed control equipment.
- c. A rheostat shall provide a minimum of $\pm 5\%$ voltage adjustment from rated value.
 - d. Provide subtransient reactance to levels which allow for IEEE 519 harmonic mitigation. The subtransient reactance of this generator shall be set based upon the largest and most efficient alternator which will fit this generator at the maximum alternator temperature riser specified herein. Minimum subtransient reactance shall not exceed 0.0012 per unit.
8. The generator, exciter, and voltage regulator shall be designed and manufactured by the engine-generator set manufacturer so that the characteristics shall be matched to the torque curve of the prime mover. This design allows the prime mover to use its fullest power producing capacity (without exceeding it or over compensating) at speeds lower than rated, to provide the fastest possible system recovery from transient speed dips. A system that routinely selects a linear-type (straight line) constant volts/hertz characteristic, without regard for the engine power and torque characteristics, will not meet this specification.
 9. PMG Exciter shall be three-phase, full-wave, rectified, with heavy-duty silicon diodes mounted on the common rotor shaft and sized for maximum motor starting loads.
 10. Generator design shall be of the self-protecting type, as demonstrated by the prototype short-circuit test as described under "Testing" herein. All other generator performance criteria shall be equal to that of the specified equipment.
- D. Engine-Generator Set Control:
1. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification. The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered. The generator set mounted control shall include the following features and functions. The control panel shall be mounted at an accessible height with all controls and screens viewable at eye level.
 2. Control Switches
 - a. Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or Manual position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - b. EMERGENCY STOP switch. Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the

- generator set to immediately shut down, and be locked out from automatic restarting.
- c. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 - d. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
3. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:
- a. Analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red. Analog meter can also be incorporated as part of the microprocessor based generator set control.
 - b. Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
 - c. Both analog and digital metering are required. The analog and digital metering equipment shall be driven by a single microprocessor, to provide consistent readings and performance.
4. Generator Set Alarm and Status Display
- a. The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing warning and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on an alphanumeric digital display panel:
 - low oil pressure (alarm)
 - low oil pressure (shutdown)
 - oil pressure sender failure (alarm)
 - low coolant temperature (alarm)
 - high coolant temperature (alarm)
 - high coolant temperature (shutdown)
 - engine temperature sender failure (alarm)
 - low coolant level (alarm or shutdown—selectable)
 - fail to crank (shutdown)
 - fail to start/overcrank (shutdown)
 - overspeed (shutdown)
 - low DC voltage (alarm)
 - high DC voltage (alarm)

- weak battery (alarm)
 - low fuel-daytank (alarm)
 - high AC voltage (shutdown)
 - low AC voltage (shutdown)
 - over frequency
 - under frequency (shutdown)
 - over current (warning)
 - over current (shutdown)
 - short circuit (shutdown)
 - ground fault (alarm) (optional—when required by code or specified)
 - over load (alarm)
 - emergency stop (shutdown)
 - generator reverse power (shutdown)
 - loss of excitation (shutdown)
 - instantaneous over excitation (shutdown)
 - time over excitation (shutdown)
 - loss of sensing (shutdown)
 - loss of PMG (alarm)
- b. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.
5. Engine Status Monitoring
- a. The following information shall be available from a digital status panel on the generator set control:
 - i. engine oil pressure (psi or kPA)
 - ii. engine coolant temperature (degrees F or C)
 - iii. engine oil temperature (degrees F or C)
 - iv. engine speed (rpm)
 - v. number of hours of operation (hours)
 - vi. number of start attempts
 - vii. battery voltage (DC volts)
 - b. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.
 - c. Provide auxiliary dry contacts for remote indication for the following:
 - i. Generator Run Status
 - ii. Generator Failure Alarm
 - iii. Generator Warning Alarm
 - iv. Low Fuel Alarm
 - v. Fuel Rupture Alarm

- vi. Low Battery Alarm
6. Engine Control Functions
- a. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
 - b. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
 - c. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
 - d. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
 - e. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components and actual failure conditions.
7. Alternator Control Functions
- a. The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
 - b. Controls shall be provided to monitor the output current of the generator set and initiate and alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.
 - c. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system

- shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.
- d. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
 - e. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
 - f. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 12VDC or more than 16 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and if DC voltage drops to less than 8 volts for more than two seconds a “weak battery” alarm shall be initiated.
- E. Auxiliary Equipment:
- 1. Starting Battery: Batteries shall be supplied for each engine and shall be mounted in a battery rack within the engine-generator set skidbase. Batteries shall be 12 volt, heavy duty, diesel starting lead-acid type. Provide number of batteries based on starting requirements of generator.
 - 2. Battery Charger(s): A voltage regulated battery charger shall be provided for each engine-generator set. Chargers shall be equipped with float, taper, and equalize charge settings. The battery charger shall provide dry contact alarms for loss of AC power, weak battery, and high battery.
 - 3. External emergency stop station, break-glass type, for mounting outside room housing the prime mover. Provide a NEMA 4X cast box with larger red mushroom push off and pull on type device. Depressing the emergency E-Stop shall cause the generator set to immediately shut down and be locked out from restarting. This shall operate in parallel with the unit mounted at the generator control panel. Provide an output alarm contact stating that either e-stop has been activated and add an alarm light at generator alarm panel for this requirement.

2.2 SERVICE MANUALS AND PARTS BOOKS

- A. The system manufacturer’s authorized local dealer shall furnish copies each of the manuals for each generator (total of 4 complete sets) and books listed below to be kept inside the enclosure and one set for the Owner's files for each unit under this contract. The manufacturer shall also provide four CD's with each of the manuals, instructions, lists, procedures, charts, wire diagrams, and schematics on them.

1. OPERATING INSTRUCTIONS - with description and illustration of all switchgear controls and indicators; and engine and generator controls and indicators.
2. PARTS CD - that illustrates and list all assemblies, subassemblies and components, except standard fastening hardware (nuts, bolts, washers, etc.).
3. PREVENTATIVE MAINTENANCE INSTRUCTIONS - on the complete system that cover daily, weekly, monthly, biannual, and annual maintenance requirements and include a complete lubrication chart.
4. ROUTINE TEST PROCEDURES - for all electronic and electrical circuits and for the main AC generator.
5. TROUBLESHOOTING CHART - covering the complete Genset showing description of trouble, probable cause, and suggested remedy.
6. RECOMMENDED SPARE PARTS LIST - showing all consumables anticipated to be required during routine maintenance and test.
7. WIRING DIAGRAMS AND SCHEMATICS - showing function of all electrical components, corrected as required showing as-built conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be made in complete accordance with manufacturer's recommendations.
- B. Install unit on concrete base to provide for servicing access and oil pan removal.
- C. Flexible connections shall be used on all connections to unit.
- D. Fill the engine cooling system with a solution of 50 percent ethylene glycol and water.
- E. Support muffler so that its weight is not supported by the engine. Exhaust pipe sizing shall be as required to maintain exhaust backpressure within the limits established by the generator set manufacturer.
- F. Bond steel base, generator and engine frames and all equipment enclosures to main ground electrodes.
- G. Provide a minimum of 4 - 3/4" stainless steel epoxy anchors to fasten the generator to the concrete foundation.
- H. The external emergency E-Stop switch for remote mounting shall be installed outside of the generator room as shown on drawings.

3.2 FIELD TESTS AFTER INSTALLATION

- A. The complete installation shall be initially started and checked out for operational compliance by factory-trained representative(s) of the engine-generator set(s) manufacturer. The engine lubrication oil as recommended by the manufacturer for operation under environmental conditions specified, shall be provided by the engine-generator set(s) supplier.
- B. Upon completion of initial start-up and system checkout, the supplier of the system shall perform a field test in the presence of the Contractor, Engineer and Owner's operating personnel to demonstrate load carrying capability and voltage and frequency stability.
- C. The Contractor shall supply fuel for generator, water for pumps, and complete electrical system operating and functional in order to verify that generator will start

the connected loads in the order specified and load bank testing.

- D. 100% Load shall consist of resistive load bank. Unity power factor is suitable for on-site testing, provided that rated load tests at power factor have been performed by the manufacturer prior to shipment.
1. Records shall be maintained throughout the tests consisting of:
 - a. Time-of-day
 - b. Coolant temperature
 - c. Cranking time until prime mover starts and runs
 - d. Time required to come up to operating speed, voltage and frequency overshoot
 - e. Time required to achieve steady-state condition with all switches transferred to the emergency position
 - f. Voltage
 - g. Frequency
 - h. Current
 - i. Oil pressure
 - j. Ambient air temperature
 - k. Kilowatts
 - l. Power factor
 - m. Battery charger rate at 5 minute intervals for the first 15 minutes
 2. Data shall be recorded at 15 minute intervals throughout the test.
 3. Continue this load test for 2 hours per NFPA 110, observing and recording load changes and the resultant effect on voltage and frequency.
 4. Return normal power, record the time delay on retransfer for each switch (set for 15 minutes minimum) and the time delay on prime mover cooldown period and shutdown.
 5. Upon completion of the above test, allow the prime mover to cool for 5 minutes. Then apply available building load via Automatic Transfer Switch. A power failure shall be initiated by opening all switches or breakers supplying the normal power to the building or facility. This load pickup shall be in one step immediately upon reaching rated RPM.
 6. During or after the tests, the Owner's operating personnel shall be fully instructed by the factory-trained representative in the operation and maintenance of this equipment.
 7. Perform a building load test with the actual conditions of the load. This must be coordinated as a separate site visit for each station. Coordinate with Owner and Engineer to setup time and conditions of testing.
 8. The manufacturer's representative shall test and verify all protective functions of the generator control by accessing the control system through the use of a laptop computer and simulating failure modes or fault conditions.
 9. Perform and test sound level values for each of the sites based on conditions set forth in the specifications.
 10. The contractor is responsible to provide the volume of fuel necessary to perform all testing for final acceptance of the equipment and shall coordinate final fuel requirements with the owner after final acceptance.

STANDBY POWER SYSTEM - RESISTIVE LOAD BANK TEST

Owner: _____ Date: _____

Project: _____

Contractor: _____

Equipment
Manufacturer: _____

Equipment: _____

This certifies that the entire equipment/system has met the RESISTIVE LOAD BANK TESTING requirements of Section 16620, 16950 and all other applicable requirements of the contract documents.

(Authorized Representative of the Manufacturer) (Date)

(Contractor) (Date)

(Engineer) Wright-Pierce (Date)

STANDBY POWER SYSTEM - BUILDING LOAD TESTS

Owner: _____ Date: _____

Project: _____

Contractor: _____

Equipment
Manufacturer: _____

Equipment: _____

TEST #1

TEST #2

TEST #3

This certifies that the entire equipment/system has met the BUILDING LOAD TESTING requirements of Section 16620, 16950 and all other applicable requirements of the contract documents.

(Authorized Representative of the Manufacturer) (Date)

(Contractor) (Date)

(Engineer) Wright-Pierce (Date)

END OF SECTION

SECTION 16950START-UP AND TESTING OF ELECTRICAL SYSTEMSPART 1 - GENERAL1.1 DESCRIPTION

- A. Test and demonstrate, to the satisfaction of the Engineer, all electrical devices in accordance with the following requirements. All testing and checkout of equipment specified under this Section shall be performed the electrical contractor.
- B. During the checkout and startup period, the electrical contractor shall provide sufficient personnel to aid with the start-up of all electrical equipment, to remove any faults, and to make the necessary adjustments for the proper operation of electrical equipment and installation.
- C. A 1000 volt "megger" insulation test shall be available at all times during the testing of power feeders and motor wiring.
- D. All electrical equipment, wiring, switches and insulators found to be defective or to have failed due to poor workmanship shall be replaced promptly at no additional cost to the Owner.

1.2 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, 16010 and as specified in this section.
- B. It should be the Contractors responsibility to provide all required forms/direction as to submittal procedures for this contract and to verify compliance prior to submitting to the Engineer for review.
- C. A record of all insulation values shall be properly recorded as listed in worksheet attached to the back of the section. All time intervals shown shall be recorded for each conductor being tested.
- D. Ground testing results shall be properly recorded, witnessed, and reported to the Engineer.
- E. A complete binder and documentation of the results of all testing shall be submitted for a final record of all testing and settings for the entire system.
- F. All circuit breaker settings and testing shall be provided in order to check for proper cable connections, impedance testing and infra-red testing of all connections of all electrical equipment, cables, devices and distribution system equipment for the entire project at all locations.

1.3 TESTING REQUIREMENTS

- A. Prior to the start of check out and testing, insure that all equipment is properly and permanently identified according to Section 16010.
- B. Before energizing any electrical equipment or apparatus, thoroughly check all equipment for the following:
 - 1. All equipment and materials shall be clean, dry and free of foreign materials.

START-UP AND TESTING OF ELECTRICAL SYSTEMS

2. Vacuum clean to make free from filings, foreign matter or other materials left inside equipment or enclosures. Particular attention shall be given to bus conductors, conductors, terminal blocks, and windings.
 3. Check for tools inside equipment or enclosures. All screw, bolt, and terminal connections shall be checked for tightness as specified by the equipment manufacturer.
 4. Check the bearings of all rotating electrical apparatus and, if required, have supplier fill with the grease or oil as recommended by the manufacturers.
 5. All motors, contacts, relays, bus, insulators and other electrical apparatus shall be cleaned and dried out if required and/or needed. Drying out methods will be such that the insulation temperature of the apparatus does not exceed 90°C.
- C. Prior to applying voltage to any apparatus or circuit, make insulation resistance tests and, if necessary, dry the apparatus until resistance values conform to the standards of IEEE.
 - D. In case of a low resistance circuit insulation, eliminate the problem before the circuit is energized.
 - E. Provide 1000 volt "Megger" insulation testing on all 600 volt feeder conductors and motor power conductors. This shall include any and all of the existing electrical feeder cables at the facility which shall remain and shall be reconnected. Motors shall be meggered from the starters.
 - F. "Megger" test all required service feeder cables and circuit wiring at the existing facility in their entirety and submit a complete test report. 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.
 - G. Panelboard's line currents shall be balance to within 10% of each other.
 - H. 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.
 - I. All main plant building loops and major equipment grounds shall be tested to remote earth or directly referenced to an extremely low resistance (approximately 1 ohm) reference ground bench mark. Tests shall be made with ground testing ohm meter or "megger" approved by the Engineer for the purpose.
 - J. The ground resistance of the individual networks shall be measured at two points with the cables at all the test points disconnected.
 - K. Test the grounding system to assure continuity and to assure that resistance to ground does not exceed specified limits or form any ground loops.
 - L. The entire grounding network resistance shall be meggered. Resistance shall not exceed 25 ohms. Drive additional ground rods if necessary.
 - M. The Contractor shall provide load readings for all equipment, switchgear, motor control centers and panelboards.
 - N. 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.
 - O. 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.
 - P. Provide and check all overload relays settings and sizing for all motors and submit

this data to the Engineer for final approval. This shall include settings and adjustments to MCP devices for each motor starter.

- Q. The contractor shall maintain a complete marked up drawing set and all written documentation of all changes at the job site. These documents shall be made available to the Engineer at all times.
- R. Set all short circuit, coordination and arc flash study settings and requirements based upon the final system study and recommendations. Provide written documentation that this has been completed.

1.4 DEMONSTRATION AND START UP

- A. All equipment shall be properly identified as indicated in SECTION 16010.
- B. 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.
- C. 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.
- D. 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.
- E. All demonstrations and instructions shall be scheduled at the convenience of the Engineer and the Owner and shall be scheduled with at least seventy-two (72) hours written notice.
- F. Set all circuit breaker and overcurrent devices based on overall system coordination and short circuit study. Final acceptance will not be allowed until all settings and protective devices are set, checked, tested, and verified in the field in the presence of the Engineer.
- G. All control circuits shall be functionally checked to see that their operation and sequence are correct. Any adjustable switches such as float switches, limit switches and timers shall be adjusted for proper operation.
- H. Just prior to acceptance of the lighting facilities, clean all lighting fixtures and re-lamp where required at no additional cost to the Owner.
- I. All local control stations and control panels for equipment specified in DIVISIONS 11, 13, 14, 15 and 16 shall be demonstrated to function properly of all items under simulated operating conditions unless otherwise specified elsewhere.

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.
Phase A-Gnd.												
Phase B-Gnd.												
Phase C-Gnd.												
Phase A-Phase B												
Phase A-Phase C												
Phase B-Phase C												

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.
Phase A-Gnd.												
Phase B-Gnd.												
Phase C-Gnd.												
Phase A-Phase B												
Phase A-Phase C												
Phase B-Phase C												

*Notes: Megger test only should record 5 minutes value...
Polarization Index (P.I.) is 10 min reading divided by 1 min reading
Note: If a neutral is provided, this will also need to be tested*

END OF SECTION

APPENDIX A
Geotechnical Data Report

WELTI GEOTECHNICAL, P.C.

Formerly Dr. Clarence Welti, PE. PC.

227 Williams Street · P.O. Box 397
Glastonbury, CT 06033-0397

(860) 633-4623 / FAX (860) 657-2514

August 31, 2017

Ms. Nicole Ouimet, EIT
Wright Pierce Engineers
169 Main Street, 700 Plaza Middlesex
Middletown, CT 06457

Re: Geotechnical Study for Proposed New Cider Mill Pump Station, Cider Mill Road, Glastonbury, CT

Dear Ms. Ouimet:

1.0 Herewith are the test boring data pertaining to the subject project. One boring was drilled to a depth of 19.5 feet below the existing grade. The boring was cored 5 feet into the bedrock. *The borings were drilled by Clarence Welti Associates, Inc. solely to obtain indications of subsurface conditions as part of a geotechnical exploration program. No services were performed by Welti, Geotechnical, P.C. to evaluate subsurface environmental conditions.*

2.0 The **Subject Project** will include the placement of new Pump Station adjacent to the existing pump station located at the end of Cider Mill Road in Glastonbury, CT. The bottom of the existing ejector station is about 22 feet below grade plus an 18" pad beneath the station. The record drawings indicate the existing station is on bedrock.

3.0 The **Geologic Origin** of the natural inorganic soils in the subject area are from glacial moraine deposits overlying weathered bedrock and eventually residual unweathered bedrock. The bedrock is Glastonbury Gneiss. The rock has about 25° foliation.

3.1 The **Soil/ Rock Cross Section** from the test boring is as follows:

Bituminous Concrete to 5"

Possible FILL or disturbed soil; fine to coarse SAND, little to some Silt, little Gravel to 13 feet, medium compact

Note: These soils were probably within the backfill zone of the existing pump station manhole.

Weathered Bedrock to 14.5 feet

Bedrock; Glastonbury Gneiss

Note: The rock core taken from 14.5 to 19.5 feet had a recovery of 57% and an RQD of 20%

3.2 The Water Table, was not where evident in the borehole at boring completion.

3.3 The Estimated Properties of the moraine deposit and sand and gravel backfill are as follows:

Material	Unit Weight	Submerged Unit Weight	Angle of Internal Friction	Active Coefficient	Passive Coefficient
Natural Moraine	130	68	34	0.27	4.0
Sand and Gravel	125	62	32	0.28	3.5

3.4 Excavation of hard rock below 14 feet would normally require blasting for rock removal. Hoe ramming would be a rock excavation option, but it may not be the most economical procedure. With hoe ramming there would a requirement for a number of initial drill holes to develop a face for chipping the rock.

4.0 It is presumed that a substantial depth of excavation would be in bedrock and that the base of the wet well or ejector station would be on bedrock. It is recommended that the bottom of the excavation receive minimum 6" layer of 3/8" crushed stone as a leveling layer beneath the bottom slab. Backfill of the well, where in rock should be 3/8" crushed stone to avoid possible a bridging on an erratic rock face. The backfill for the portion of the well in soil should be with the material cited below

Percent Passing	Sieve Size
100	3.5"
50 - 100	3/4"
25 - 100	No.4

The fraction, passing the No.4 sieve should have less than 15%, passing the No. 200 sieve.

In general, the onsite excavated soils will not meet the above gradation.

The soil to 4 feet below the finished pavement grades should be compacted to at least 95% of modified optimum density in accordance with ASTM D-1557. Below 5 feet the soil should be compacted to at least 92% of modified optimum density. One option would be to use 3/8"

crushed stone up to within 4 feet of grade to avoid compaction issues.

4.1 The **allowable bearing pressure** on the crushed stone atop the bedrock could be 4 Tons/sf.

4.2 For **uplift** calculations the crushed stone unit weight is about 105 pcf.

5.0 Regarding **earthwork in general**, the excavations would generally be in OSHA Type C soils, which would require sloping of unshored excavations, which exceed 5 feet in height to slopes less than 34° from the horizontal (1.5H :1V). This is standard OSHA language and should be used on plans and specifications to avoid possible future claims against engineers.

5.1 **Sheeting design** can be based on parameters cited in section 3.3 above.

6.0 This report has been prepared for specific application to this project in accordance with generally accepted soil and foundation engineering practices. This study addresses the geotechnical requirements for the proposed sewer and water installations only. No other warranty, express or implied, is made. In the event that any changes in the nature, design and location of structures are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

The analyzes and recommendations submitted in this report are based in part upon data obtained from referenced explorations. The extent of variations between explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

Wolti Geotechnical, P.C., should perform a general review of the final design and specifications in order that geotechnical design recommendations may be properly interpreted and implemented as they were intended. The existing topography, the bridge type and potential scour depths have not been determined. This report will require supplemental input to address specific areas of concern, when the information is available. Special conditions may only be apparent when the above information is available for review by the writer.

If you have any questions please call me.

Very truly yours,

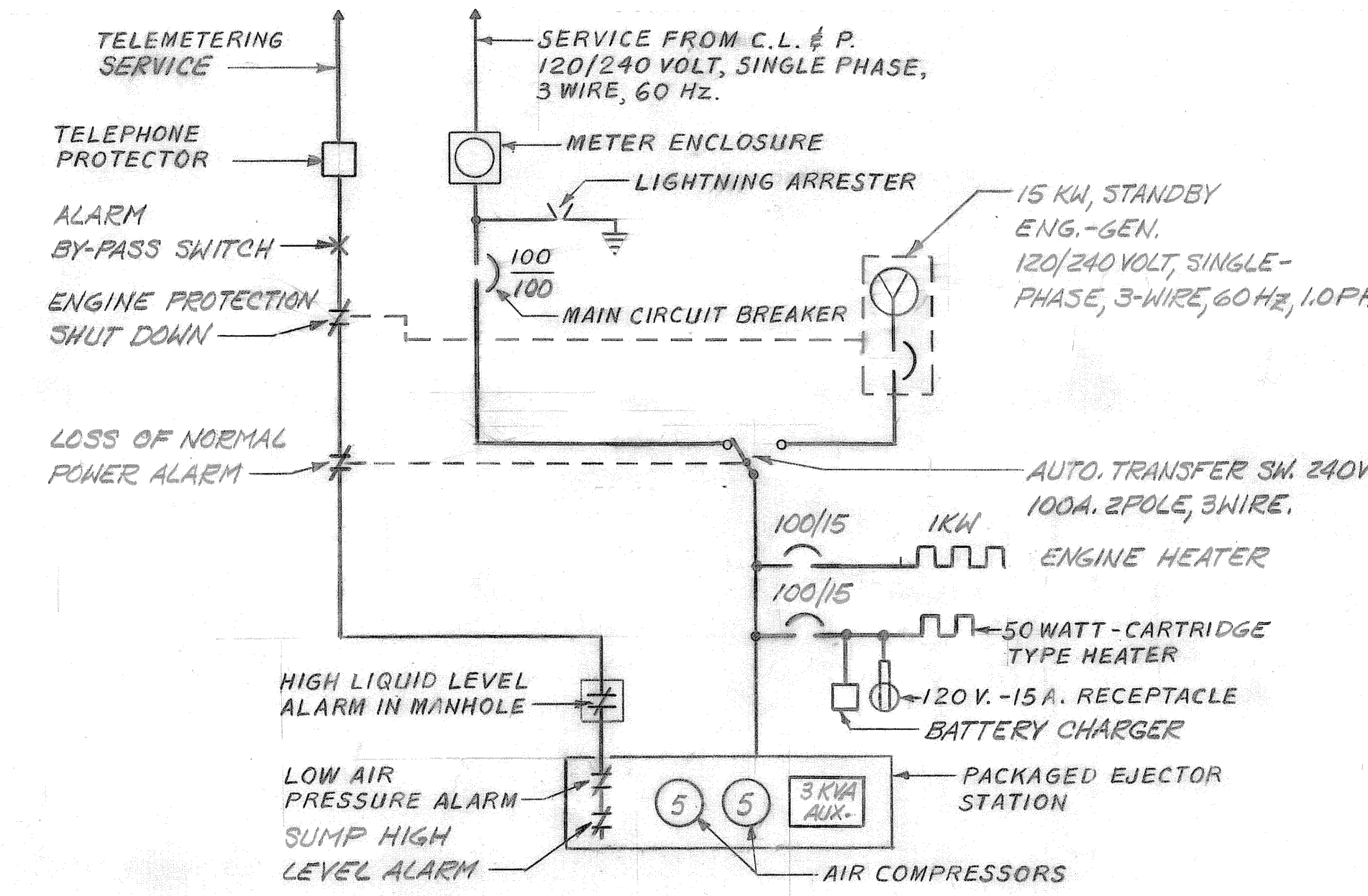
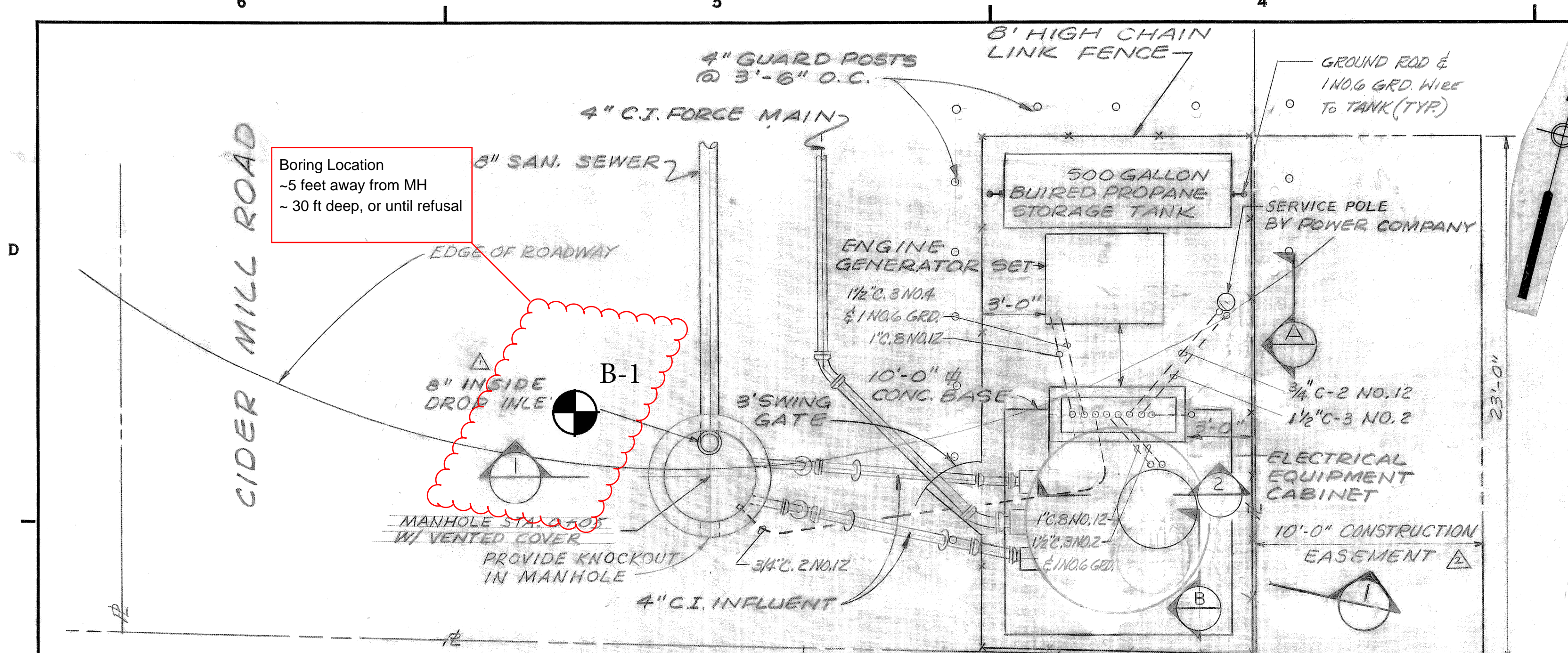


Max Welti, P.E.

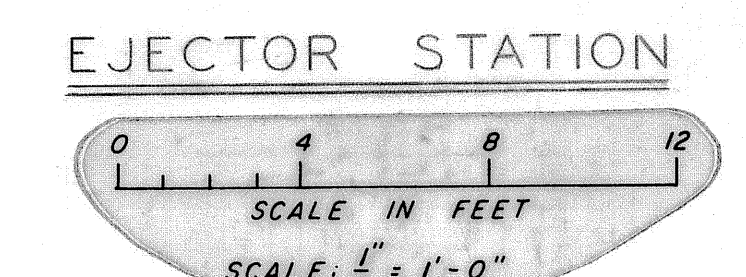
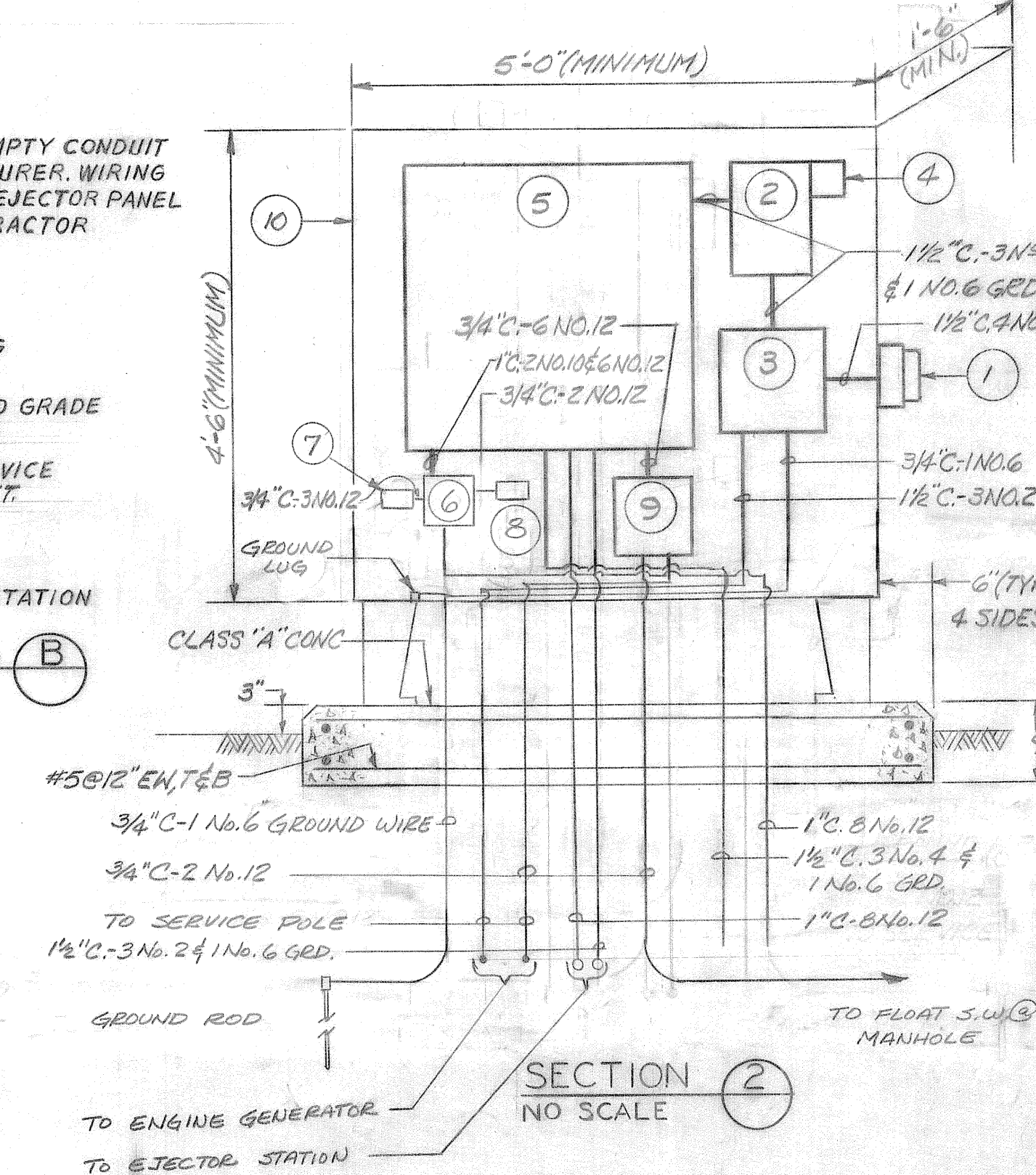
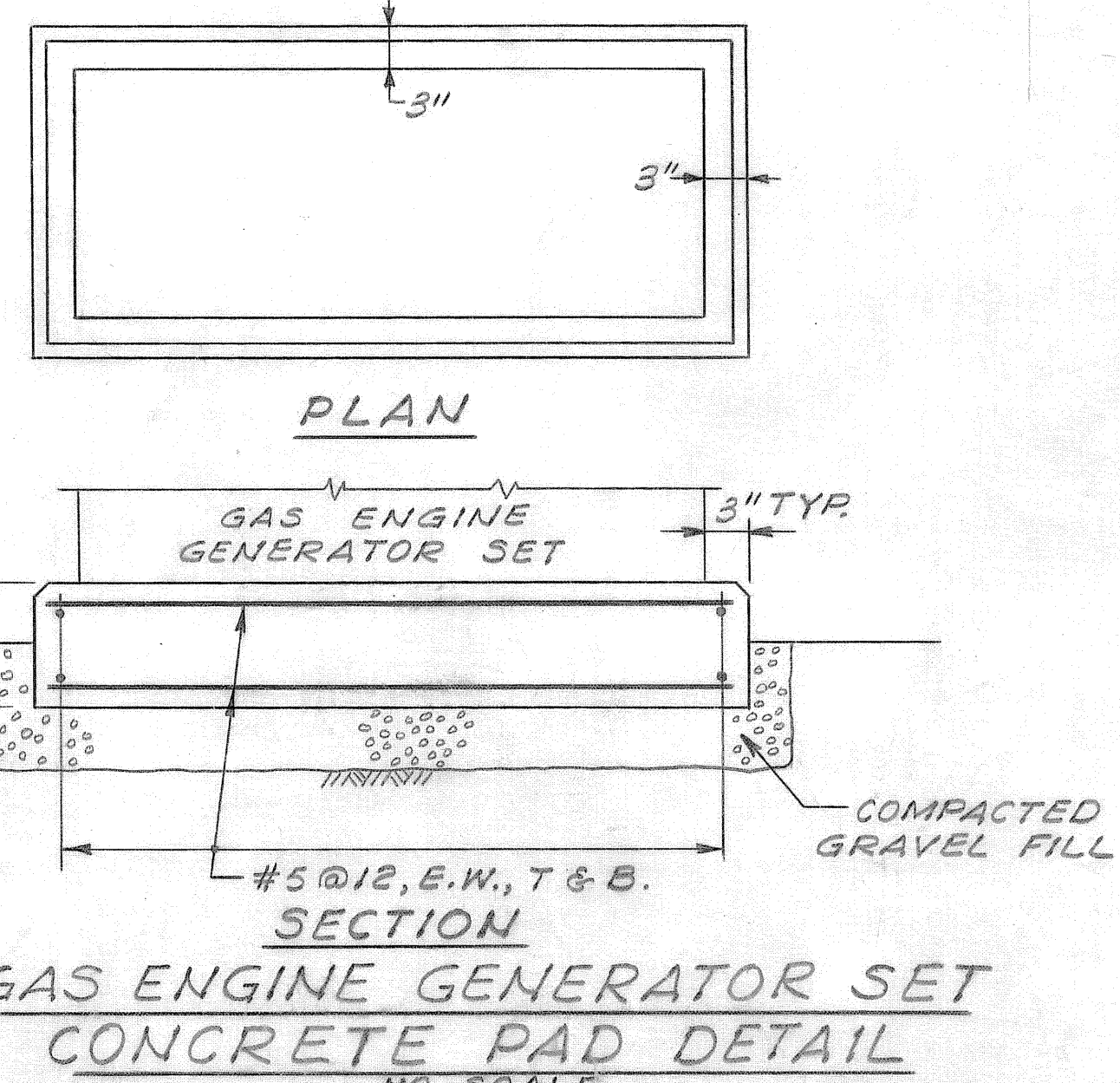
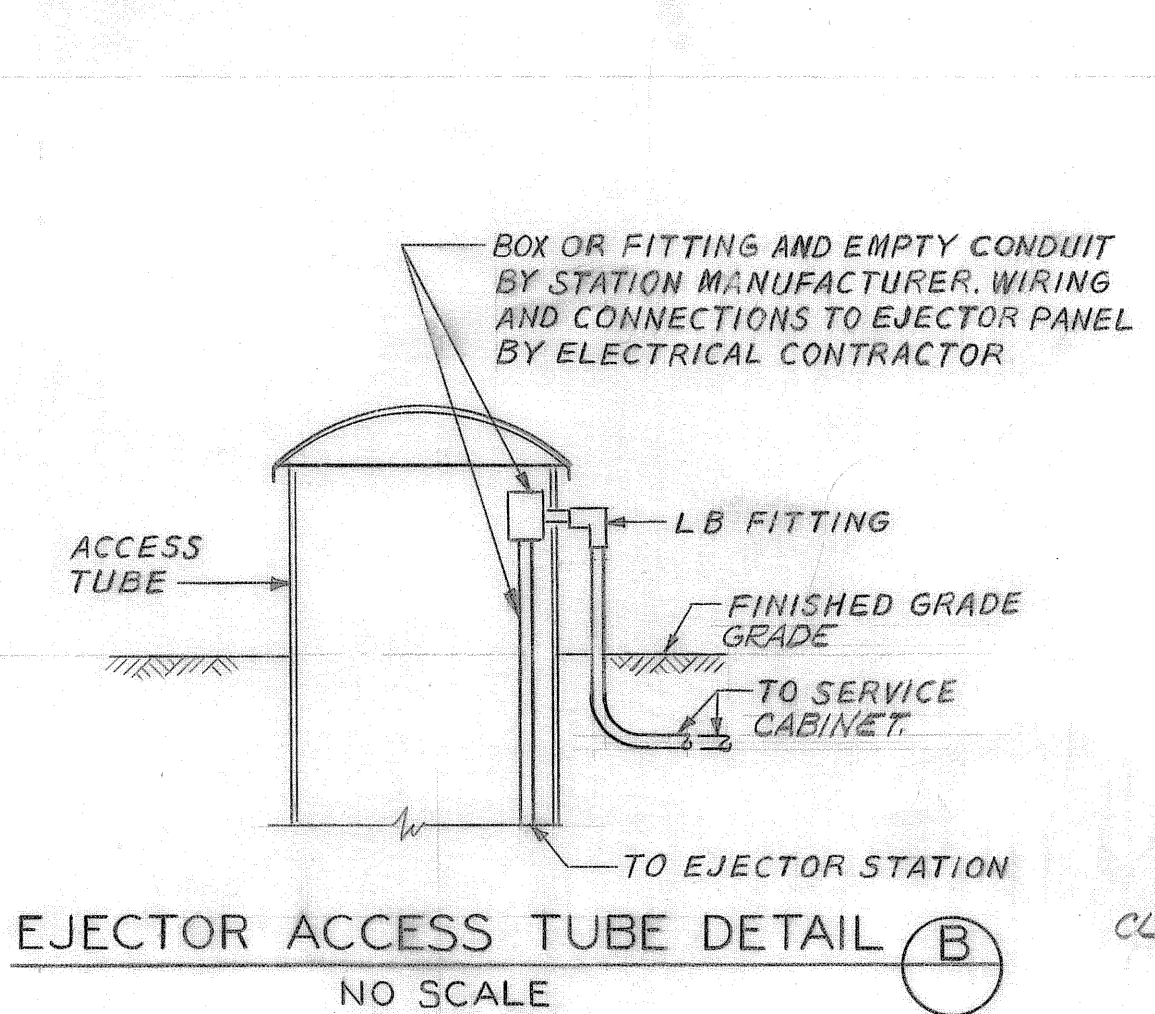
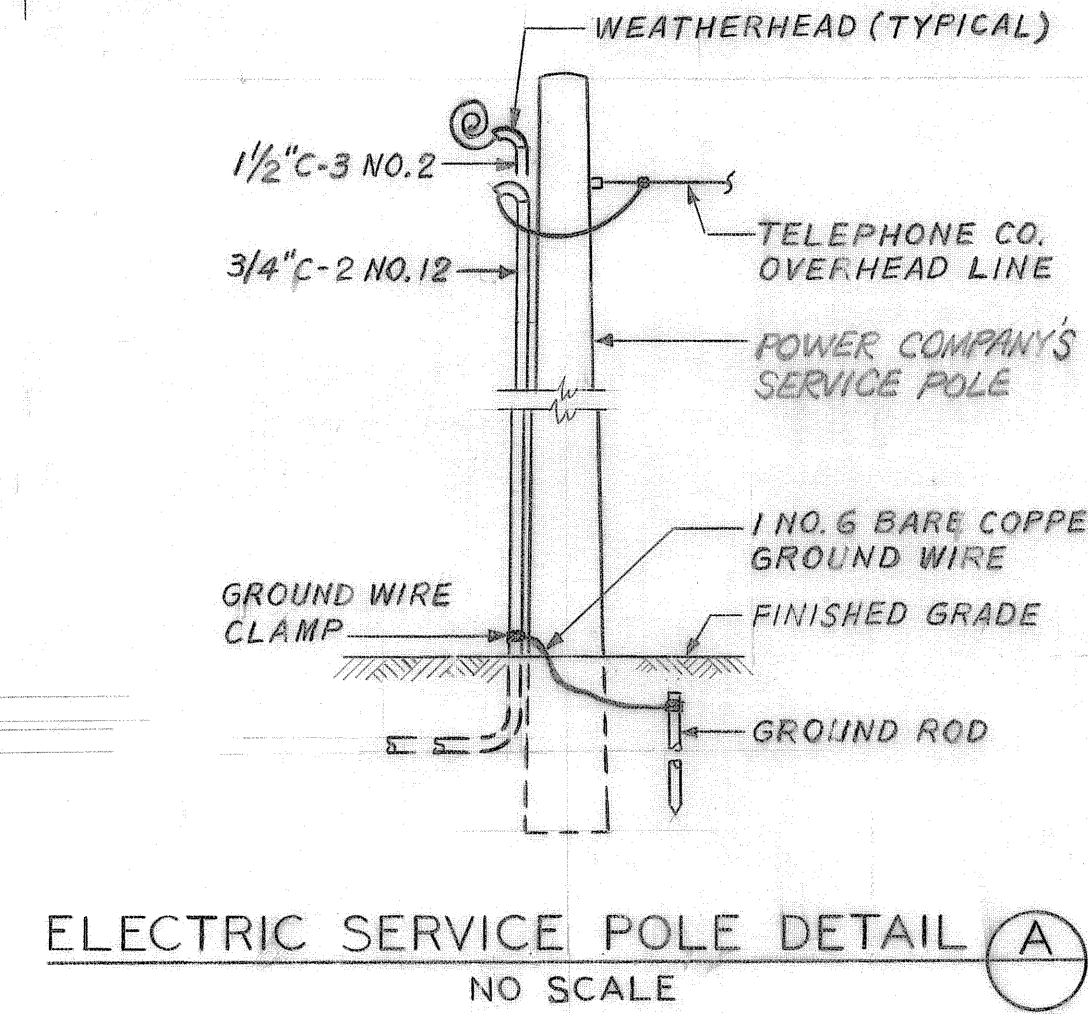
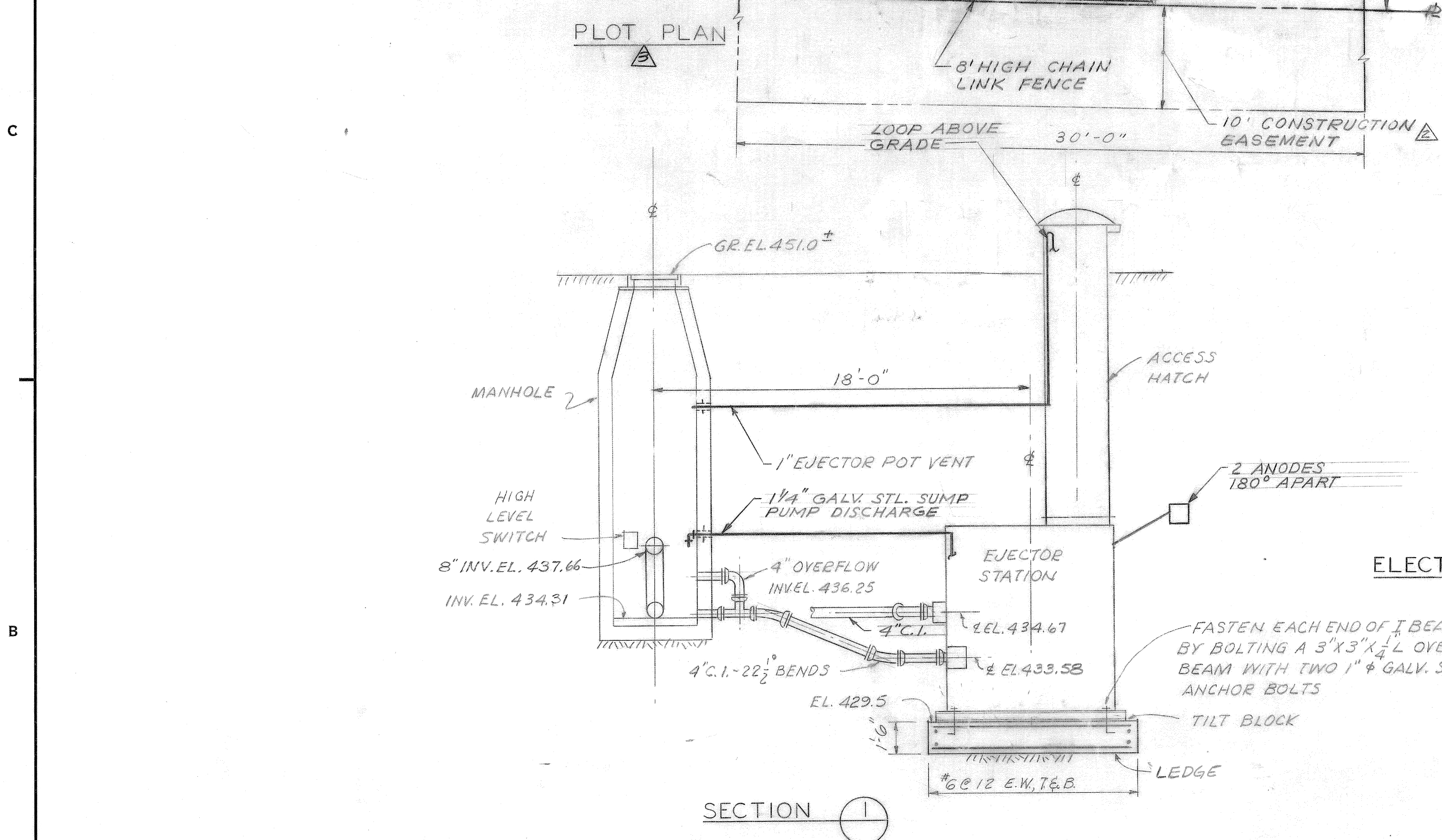


Clarence Welti Ph.D., P. E.

APPENDIX
BORING DATA



ELECTRIC CABINET EQUIPMENT	
NO.	DESIGNATION
1	METER SOCKET
2	MAIN CIRCUIT BREAKER
3	PULL BOX NEMA 1
4	LIGHTNING ARRESTER
5	AUTOMATIC TRANSFER SWITCH
6	CIRCUIT BREAKER LOAD CENTER
7	DUPLEX RECEPTACLE
8	TYPE "E" FITTING WITH PORCELAIN EDISON BASE SOCKET AND 50 WATT, 120 VOLT CARTRIDGE TYPE HEATER.
9	HINGED ALARM BOX NEMA 1 WITH TELEPHONE LINE PROTECTORS AND FRONT MOUNTED BYPASS SWITCH.
10	ELECTRICAL EQUIPMENT CABINET FOR DETAILS SEE SPECIFICATIONS



TEST BORING LOCATION
CLARENCE WELTI ASSOCIATES, INC.
8/23/17

NUMBER	DATE	MADE BY	CHECKED BY	DESCRIPTION
1	2/20/80	BWM	B. Waller	RECORD DRAWINGS
2	3/28/78	J.F. Evans	W. Moore	ADDED GAS ENGINE GENERATOR SET CONG. PAD DETAIL
3	2-28-78	E. FICARD	M. Hanlon	ADDED EMERG. ENGINE-GEN. EQUIPMENT
4	2/23/78	Warrenton	M. Hanlon	RELOCATE EJECTOR STATION
5	11-14-77	Condon	M. Hanlon	ADD CONSTRUCTION EASEMENT
6	6-24-77	Bethea	M. Hanlon	DROP INLET REVISION

DRAWN BY: B. Waller
DEPT. CHECK: M. Hanlon
PROJ. CHECK: M. Hanlon

DAVID W. PAULSON
REGISTERED PROFESSIONAL ENGINEER
NO. 8538

ALLEN F. GOLLUB
REGISTERED PROFESSIONAL ENGINEER
NO. 8538

M&E METCALF & EDDY, INC. ENGINEERS
BOSTON • NEW YORK • PALO ALTO • CHICAGO

David W. Paulson
REG. PROF. ENGR. MASS., NO. 1F107
DATE: 5/24/77

UNLESS OTHERWISE NOTED OR CHANGED BY REPRODUCTION

SCALE: AS SHOWN

TOWN OF GLASTONBURY, CONNECTICUT
SANITARY SEWERS, FORCE MAINS, EJECTOR STATION AND APPURTENANT WORK
EJECTOR STATION
ELECTRICAL AND MECHANICAL

JOB: 5828
FILE NO.: H-74462-1
CONTRACT: 77-1
SHEET: 20 OF 20

RECORD DRAWING

GLASTONBURY PUBLIC WORKS
FILE:
STREET:
CIDER MILL ROAD
SHEET NO. 16

CLARENCE WELTI ASSOC., INC. P.O. BOX 397 GLASTONBURY, CONN 06033				CLIENT WRIGHT PIERCE ENGINEERS		PROJECT NAME PROPOSED NEW CIDER MILL PUMP STATION	
						LOCATION CIDER MILL ROAD, GLASTONBURY, CT	
	AUGER	CASING	SAMPLER	CORE BAR.	OFFSET	SURFACE ELEV.	HOLE NO. B-1
TYPE	HSA		SS	NQ	LINE & STA.	GROUND WATER OBSERVATIONS	
SIZE I.D.	3.75"		1.375"	2.0"	N. COORDINATE	AT none FT. AFTER 0 HOURS	START DATE 8/23/17
HAMMER WT.			140lbs		E. COORDINATE	AT FT. AFTER HOURS	FINISH DATE 8/23/17
HAMMER FALL			30"				
DEPTH	SAMPLE			A	STRATUM DESCRIPTION + REMARKS	ELEV.	
	NO.	BLOWS/6"	DEPTH				
0					ASPHALT	0.40	
	1	4-4-5-6	1.0'-3.0'		BR.FINE-CRS.SAND, LITTLE TO SOME SILT, LITTLE GRAVEL		
	2	7-7-6-5	3.0'-5.0'				
5	3	4-7-6-6	5.0'-7.0'				
10	4	3-4-6	10.0'-11.5'				
					WEATHERED ROCK	13.0	
15					CORED BEDROCK - GNEISS	14.5	
					RUN #1 14.0' - 19.0' RECOVERED 34" RQD = 20%		
20					BOTTOM OF BORING @ 19.5'	19.5	
25							
30							
35							
LEGEND: COL. A: SAMPLE TYPE: D=DRY A=AUGER C=CORE U=UNDISTURBED PISTON S=SPLIT SPOON PROPORTIONS USED: TRACE=0-10% LITTLE=10-20% SOME=20-35% AND=35-50%						DRILLER: K. CHRISTIANA INSPECTOR:	
						SHEET 1 OF 1	HOLE NO. B-1

APPENDIX B

Hazardous Materials Abatement Requirements and Test Reports

APPENDIX B

ABATEMENT OF PCB-CONTAINING MATERIALS

PART 1 - GENERAL

1.01 SUMMARY:

- A. All PCB-abatement work described in this Section shall be the responsibility of the Abatement Contractor (hereinafter referred to as the Contractor) unless specifically designated as being the responsibility of the Engineer. Following the abatement of PCB-containing building materials, the General Contractor may designate other subcontractors to perform restoration work. The Contractor shall be responsible for providing all labor, materials, and equipment needed to perform the scope of PCB Abatement work. PCB Abatement is being performed under a performance-based disposal as described under §761.62(a).
- B. This section describes requirements for the abatement of known polychlorinated biphenyls (PCB) containing paint with PCB detections greater than 1 milligrams per kilogram (>1 mg/kg). PCB abatement activities will be performed within The Cider Mill Pump Station. Table 1 below provides a list of the building materials that have been characterized at the WPCF as containing PCBs >1 mg/kg. This section also describes requirements for the abatement of PCBs in building substrates in contact with PCB-containing paint and materials containing both lead and PCBs. For materials containing both lead and PCBs, the regulations for disposal of PCB contaminated waste prevails.
- C. The Contractor shall be responsible for reviewing the Hazardous Building Materials Survey report and Sections applicable to the abatement of other hazardous materials. The Contractor shall confirm which PCB-containing building materials may also contain asbestos or lead and the presence other hazardous materials within the PCB abatement work areas. The Contractor shall comply with the requirements of other hazardous building material abatement specifications as necessary during the performance of PCB abatement activities and for disposal of wastes generated if they are mixed with other hazardous wastes.
- D. The Contractor shall be responsible for controlling dust generated during abatement and for erecting containments to control and limit the spread of PCB-containing dust. The Contractor shall be responsible for performing dust monitoring outside of containments erected by the Contractor. The Contractor shall perform repairs on containments as necessary during the performance of the work to limit dust emissions. The Contractor shall also be responsible for repairing the containment if instructed to do so by the Engineer.
- E. The materials identified in Table 1 and the building materials removed within them shall be disposed of as PCB bulk product waste in accordance with the

- Environmental Protection Agency's (EPA) PCB regulations found in the Code of Federal Regulations, Chapter 40, Part 761 (40 CFR 761). The disposal facility shall be permitted to accept PCB bulk product waste and be of a type listed in §761.62(a)(1) through (6), inclusive. Temporary barriers, such as polyethylene sheeting associated with containments used for PCB Abatement activities, shall be removed and disposed of as PCB bulk product waste with the materials abated within the containment.
- F. The Contractor shall be responsible for the decontamination of materials and equipment that contact PCB wastes during the performance of the work or shall be required to dispose of the materials with the PCB bulk product wastes. Decontamination procedures employed by the Contractor shall comply with the requirements of §761.79(b) or (c).
 - G. Selection of means and methods for the abatement of PCB-containing building materials and substrates, containments to be employed, and proposed disposal facilities for wastes are the responsibility of the Contractor. The Contractor shall submit a PCB Abatement Plan (the Plan) that describes abatement methods, containment construction, proposed disposal facilities for all wastes generated during abatement, and decontamination procedures. The Engineer shall provide comment on the Plan. The Contractor shall be responsible for revising the Plan as requested by the Engineer and no PCB abatement work shall be performed by the Contractor until the comments have been resolved.
 - H. The Contractor shall not test building materials for PCBs without the written approval to do so from the Owner or Engineer.
 - I. Exposure to PCB-containing materials may pose health hazards to site workers and other site occupants. Contractor shall appraise all workers, supervisory personnel, subcontractors and consultants who will be at job site of the hazards. The Contractor shall be solely responsible for the health and safety of their workers and for preparing a Health and Safety Plan (HASP) for the scope of work. The Contractor shall submit their HASP to the Engineer prior to performing PCB abatement work.
 - J. Where, in the performance of the abatement work were other site workers, supervisory personnel, subcontractors, or consultants may encounter, disturb or otherwise function in the immediate vicinity of PCB-containing materials, the Abatement Contractor shall employ control measures as necessary to protect others from exposure.

Table 1
 PCB-Containing Building Materials
 Cider Mill Pump Station

Material Description	Location	PCBs (mg/kg)
Dark Brown Paint	Exterior	ND
Yellow and Green Paint	Cylinder (drywell)	86
Brown Paint	Harness Holder	46
Blue Paint	Interior Equipment in Drywell	46
Silver Gray Paint	Interior Equipment and Floor	46

1.02 SCOPE OF WORK

A. The scope of work identified herein shall be performed in accordance with the requirements of this Section, all applicable Federal, State, and local regulations, and related sections of the project specification. The Contractor's PCB Abatement Plan shall demonstrate how the Contractor shall comply with these requirements. Any alterations or changes to these requirements in the Contractor's Plan shall be requested in writing prior to the commencement of the work and must be reviewed by the Engineer prior to performing the work. Any disputes with the locations or quantities of this Section shall be reviewed prior to commencement of work or the Contractor performs such work at risk of non-payment. The Contractor shall perform the following at the Site in accordance with this specification:

1. The Contractor shall abate the materials listed in Table 1. For the Cider Mill Pump Station, the Contractor shall remove the materials listed to achieve the remedial goals described within this Specification.
2. Where applicable, for PCB abatement work at the Site, the Contractor shall install containments around the abatement area and perform work in such a manner as to prevent contamination of surrounding materials and building components by the spread of dust or other PCB-impacted materials generated during abatement activities.
3. The Contractor shall remove and dispose of PCB Contaminated Materials to the limits indicated in this Section.
4. The Contractor shall decontaminate tools and equipment (hand-tools, shovels, excavator buckets, etc.) used to abate/remove PCB-containing materials in accordance with the Contractor's PCB Abatement Plan prior to removal from the work zone. The Contractor shall indicate anticipated wastes to be generated during decontamination and how these wastes will be disposed in the Contractor's PCB Abatement Plan.
5. The Contractor shall complete removal and disposal of PCB-containing materials as specified herein and as described in the Contractor's PCB Abatement Plan.
6. For areas of PCB-containing paint, the Contractor shall remove paint until there are no visible traces of paint left on the abated surface. The Engineer shall check the surface to confirm that all visual traces of paint have been removed. Full removal of the paint to the visual standard includes removal of paint from the surface abated and any depressions within the surface.
7. The Contractor shall clean all abatement areas following the completion of abatement. The Contractor shall use wet methods and vacuum with HEPA filtration as needed to remove dust and other wastes from the area. The Engineer will check the abatement areas following cleaning to determine if

the area is ready for verification sampling. The Engineer will instruct the Contractor to perform additional cleaning as necessary and the Contractor shall be responsible for performing this cleaning as instructed by the Engineer at no additional cost.

8. Any on-site containers used for temporary waste storage shall be fully enclosed or sealed containers made inaccessible to other trades or the public. All waste containers shall be stored within a Waste Storage Area that will be surrounded by temporary fencing erected by the Contractor. The Contractor shall post M_L marks on the Waste Storage Area fencing and all waste containers. The Contractor shall record the date that waste was first placed in the waste container on the M_L mark. All waste containers will be removed from the Site within 30 days of the date when wastes were first placed in the container.
9. Maintaining on-site workers' health & safety and minimizing off-site environmental impacts are the responsibility of the Contractor during the performance of PCB abatement activities. A detailed health and safety plan will be prepared by the Contractor prior to start of work describing the protocols necessary for protecting workers per Section 01380 – Health and Safety Plan. In addition, the Contractor shall continuously monitor dust using a Mini Ram, or equivalent, to ensure that fugitive dust emissions are in compliance with 310 CMR 7.09 and EPA Region 1 regulatory requirements. Dust action levels will be triggered at levels of 120 µg/m³ (80% of the regulatory limit of 150 µg/m³), at which time dust suppression techniques (e.g., wetting) will be implemented by the Contractor. The Contractor shall provide dust monitoring data/results on a daily basis, or as required by the Engineer. In addition, vehicles leaving the Site will be checked and wiped or washed down to prevent carry out of mud, dust or dirt into the public roadway.
10. The work of this Section (PCB abatement work) shall be completed and checked by the Engineer prior to performing any other subsequent work at the Site.
11. Materials to be removed and minimum abatement requirements are included in Table 2 below.

Table 2
PCB-Containing Building Materials Abatement
Cider Mill Pump Station

Material Description	Location	Abatement/Restoration
Dark Brown Paint	Exterior	Remove and dispose of structure with dark brown paint/no restoration
Yellow and Green Paint	Cylinder (drywell)	Remove and dispose of cylinder with yellow and green paint/no restoration
Brown Paint	Harness Holder	Remove and dispose of harness holder with brown paint/no restoration
Blue Paint	Interior- Equipment	Remove and dispose of equipment with blue paint/no restoration
Silver Gray Paint	Interior- Equipment and Floor	Remove and dispose of equipment and floor with silver gray paint/no restoration

1.03 REFERENCES

- A. EPA PCB Regulations, 40 CFR 761.
- B. CT DEEP PCB Regulations, Connecticut General Statutes 22a-463 through 469, inclusive.
- C. OSHA (Occupational Safety and Health Administration) CFR Title 29.

1.04 DEFINITIONS

- A. *Abatement Contractor*: Subcontractor to General Contractor responsible for performing the PCB Abatement Work described in this Section.
- B. *Authorized Personnel*: Owner or the Engineer's Representative, and all other personnel who are authorized officials of any regulating agency, be it State, Local, Federal or Private entity who possess legal authority for enforcement or inspection of the work.
- C. *Clearance Criteria*: A Visual check of all removal surfaces, performed by the Engineer.
- D. *Fixed Object*: Mechanical equipment, electrical equipment, fire detection systems, alarms, and all other fixed equipment, fixtures or other items which cannot be removed from the work area.
- E. *HEPA*: High Efficiency Particulate Absolute filtration efficiency of 99.97 percent down to 0.3 microns. Filtration provided on specialized vacuums and air filtration devices to trap particles.
- F. *PCB Bulk Product Waste*: As defined in TSCA Regulations 40 CFR Part 761.3.
- G. *PCB Remediation Waste*: As defined in TSCA Regulations 40 CFR Part 761.3.
- H. *PPE*: Personal Protective Equipment.
- I. *Work Area, Work Zone*: refers to the areas of work for the performance of the Work of this Section including, but not limited to, demarcated and/or separated locations where non-trained, non-certified personnel are not permitted to be present during the work.
- J. *PCB Contaminated Materials*: refers to the designated materials with past PCB contamination.

1.05 REGULATIONS, FEES, AND PERMITS

- A. All legally imposed charges made by local authorities for the work of this Section

involving the coordination, inspection, and approval services of all bureaus administering all applicable codes and regulations shall be provided hereunder at no additional cost to the Owner.

- B. The Contractor shall give the proper authorities all required notices or information relating to work in his charge, pay all fees necessary to obtain all official licenses, permits and certificates, and comply with the rules of the Connecticut Department of Labor.

1.06 SUBMITTALS

A. Quality Control Submittals:

1. Worker's Qualifications Data:

- a. Name of each person who will be performing the Work and their employer's name, business address and telephone number.
- b. Names and addresses of 3 similar projects (abatement of PCB contaminated caulking material and/or other similar building materials such as concrete, brick, etc.) that each person has worked on during the past 3 years and documentation of completion of appropriate PCB/Hazardous Waste training program and supervisors with appropriate PCB/Hazardous Waste supervisor training. Removal of fluorescent light ballasts is not considered a similar project.

2. Waste Transporter Permit: One copy of transporter's current waste transporter permit.

3. Disposal facility permits to accept PCB bulk product waste. Waste profile information submitted to the disposal facility and documentation that the disposal facility will accept the wastes.

- B. Pre-Abatement Submittals: Prior to the commencement of any site activities regarding the work of this Section, the Contractor shall submit and modify based upon comments of the Owner or Engineer for the following submittals:

1. PCB Abatement Work Plan

The PCB Abatement Work Plan must contain the following details:

- a. Detailed description of means and methods of establishing and verifying the engineering controls and work practices to minimize the generation or release of airborne contamination of the work zone or outside the work zone.
- b. Procedures for on-site control of dust, water, solids, control of decontamination of tools, equipment and work surfaces.
- c. A description of the abatement work area(s).
- d. A detailed project schedule of daily activities.
- e. A description of procedures to be followed for the proper analytical testing, removal, handling, transport, and disposal of PCB-containing materials and other construction debris resulting from the work of this Section.
- f. Primary and secondary disposal sites for the PCB bulk product waste.
- g. Certification signed by the Contractor stating the Contractor has read and understands the specification requirements, the requirements of the PCB regulations at 40 CFR 761 for proper handling, removal and disposal of PCB bulk product waste.

C. PCB Work Closeout Submittals:

- 1. Disposal Site Receipts: Copy of waste shipment record, certified weight slips and disposal site receipt showing the PCB-containing materials have been properly disposed.
- 2. Complete sequence of work as described in Sections 3.05(b) and 3.06.

1.07 QUALITY ASSURANCE

- A. Contractor shall provide and assure that the quality of work practices and procedures are consistent with the below listed agencies. Contractor shall utilize the latest edition, including all addenda, revisions and supplements for all regulatory agencies, codes, etc., including but not limited to:
 - 1. Environmental Protection Agency (EPA).
 - 2. Occupational Safety and Health Administration.
 - 3. State of Connecticut codes, regulations, and laws.
 - 4. All local codes, ordinances, and bylaws.

- B. Worker's Qualifications: The persons performing PCB abatement and their supervisor shall be personally experienced in PCB abatement work and shall have been regularly employed by a company performing PCB abatement for a minimum of 3 years and shall have completed OSHA hazardous materials worker training (40 hour HAZWOPER) and supervisor training.
- C. Regulatory Requirements: Comply with the referenced standards.
- D. Pre-Work, Conference: Before the Work of this Section is scheduled to commence, a conference will be held by the Owner's Representative at the Site for the purpose of reviewing the Contract Documents, discussing requirements for the Work, reviewing the Work procedures, and documents required by this section.
 - 1. The conference shall be attended by the Owner, Contractor, the PCB abatement subcontractor, and the Engineer.

1.08 PROJECT CONDITIONS

- A. Non-liquid cleaning materials, PPE and similar protective materials resulting from decontamination shall be disposed according to 40 CFR 761 and as specified in this Section.
- B. Moveable equipment, tools, sampling equipment shall be decontaminated in accordance with 40 CFR 761 and as specified in this Section prior to removal from the work zone.
- C. The location of waste containers for the temporary storage of PCB-containing materials shall be reviewed by the Engineer.

1.09 PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

- A. Workers must follow requirements and procedures of the Contractor's HASP.
- B. Workers must be trained as per OSHA and EPA requirements, have medical clearance and must have an up-to-date pulmonary function test (PFT) and respirator fit tested by a trained professional.
 - 1. A personal air sampling program shall be in place as required by OSHA.
 - 2. The use of respirators must also follow a complete respiratory protection program as specified by OSHA.

1.10 JOB CONDITIONS

- A. Posting of regulations: Display the following documents in the clean changing

area, in public view, for the full duration of the work at each pool site with PCB-containing materials:

1. Instructions for removing injured persons from work area.
2. Emergency action plan at the work site. This plan shall also include telephone numbers for hospital, doctor and Fire Department.

1.11 SPECIAL CONDITIONS

- A. The Contractor shall be aware that a Performance Based Cleanup, per EPA regulations in 761.62(a) is being performed.

PART 2 – PRODUCTS

2.01 ABATEMENT PRODUCTS

- A. Disposal Drums: Metal or fiberboard with locking ring tops, with M_L marks as required by 40 CFR Part 761 Subpart C.

- B. Vacuum Cleaners:

1. Type: Vacuums equipped with HEPA filters.

- C. Plastic Sheets:

1. Type: Minimum 10 mil., fire retardant polyethylene sheets.

- D. Containers:

1. Containers used by the Contractor for storing and/or hauling PCB-containing material shall be constructed of steel, in good condition and designed for the intended purpose of safe, secure storage of contaminated and hazardous materials during loading and transport. The containers shall be lined as required and have a secure cover that will prevent a release of material from truck during transportation. The containers and covers shall be at no additional cost to the Owner and shall be reviewed by the Engineer prior to mobilization of trucks/containers. The containers must be checked by and labeled in accordance with the U.S Department of Transportation (DOT). The containers shall be sift proof and water resistant in accordance with the DOT.

2.02 GENERAL EQUIPMENT

- A. A sufficient supply of disposable mops, rags, and sponges for work area decontamination shall be available.

PART 3 - EXECUTION

3.01 EMERGENCY PLANNING

A. Description: The Contractor shall prepare an emergency preparedness plan detailing at least the information required in this Section and in any applicable Federal, State or local regulations.

B. Details of Plan:

1. Emergency planning shall be developed prior to abatement initiation and submitted to the Engineer and the Town of Glastonbury for review.
2. Emergency procedures shall be in written form and prominently posted in the clean change area of the worker decontamination area.
3. Emergency planning shall include written notification to police, fire and emergency medical personnel of planned abatement activities, work schedule and layout of work area, particularly barriers that may affect response capabilities.
4. Emergency planning shall include considerations of fire, electrical hazards, slips, trips, and falls, spills or releases of hazardous materials and heat related injury. Written procedures shall be developed and employee training in procedures shall be provided.
5. Employees shall be trained in evacuation procedures in the event of work place emergencies.
 - a. For Non-Life-Threatening Situations: Employees injured or otherwise incapacitated shall decontaminate following normal procedures with assistance from fellow workers, if necessary, before exiting the work place to obtain proper medical treatment.
 - b. For Life-Threatening Injury or Illness: Worker decontamination shall take least priority. After measures to stabilize the injured worker, the worker shall be removed from the work place and secure proper medical treatment.

C. Telephone numbers of all emergency response personnel shall be prominently posted in the clean area, along with the location of the nearest telephone.

3.02 NOTIFICATION

A. Notify the Engineer's Representative and Owner's Project Manager a minimum of

5 working days prior to the start of PCB abatement work.

3.03 EMPLOYEE PROTECTION

- A. Comply with all applicable OSHA Requirements.

3.04 WORK AREA PROTECTION

- A. Protection of Existing Construction: Perform PCB abatement work without damage or contamination of adjacent areas and existing construction.
- B. Perform abatement activities within a designated work area and prevent migration of PCB waste materials outside of the work area.

3.05 PCB-CONTAINING MATERIAL ABATEMENT

A. General

1. Perform abatement of PCB-containing materials in accordance with this Section, Drawings, and the reviewed PCB Abatement Work Plan.
2. Use procedures and equipment as required to limit occupational and environmental exposure to PCB's when PCB-containing materials are removed in accordance with referenced standards.
3. Concrete/brick/masonry designated for disposal per this Section shall be surface cut in a straight line by a concrete saw or equivalent method, to the full depth of material, and carefully removed in a manner to prevent cross-contamination with non-contaminated materials.
4. The Contractor will monitor dust using a Mini Ram (with data logger), or equivalent, to ensure that fugitive dust emissions are in compliance with 310 CMR 7.09 and EPA Region 1 regulatory requirements. Dust action levels for PCB-related work shall be triggered at levels of $120 \mu\text{g}/\text{m}^3$ (80% of the regulatory limit of $150 \mu\text{g}/\text{m}^3$) at which time dust suppression techniques (e.g., wetting) will be implemented. Results of the dust monitoring shall be submitted to the Engineer following the completion of work.
5. The Contractor shall decontaminate tools and equipment (shovels, excavator buckets, etc.) used to abate/remove PCB-containing materials in accordance with TSCA 40 CFR 761.79 prior to removal from the work zone. The cleaning materials shall be appropriately disposed of as PCB remediation waste in accordance with TSCA regulations at a licensed disposal facility. Cleaning/decontamination shall be done in a manner to prevent cross-contamination with other equipment and areas. The Contractor shall remove and dispose cross-contaminated materials at no additional cost to the Owner.

B. PCB Abatement Sequence

The Contractor shall follow the sequence of work indicated in their PCB Abatement Plan. Abatement work shall follow the following general sequence:

1. The Contractor shall construct containments as indicated in their plan and abate PCB-containing materials as indicated in this section. The Contractor shall perform continuous air monitoring during the performance of abatement activities. The Contractor shall clean the abatement area of any dust or other debris generated during the abatement activities.
2. The Engineer shall check the abatement area to determine if the abatement work as described in this Section is complete and either instruct the Contractor to perform additional abatement or collect confirmation samples.
3. The Engineer will collect confirmatory samples of brick/concrete surfaces every 25 linear feet, or based on a 5-foot by 5-foot sampling grid, in accordance with EPA's sampling protocol for porous materials (EPA SOP Revision 4, 5/5/11) to verify they are <1 mg/kg PCBs prior to clearance being achieved. Analytical results will be available within 72 hours and the Contractor is to plan accordingly.
4. Follow procedures as described in Section 3.06 (a) through (c) to receive certification of completion of abatement activities.

3.06 CERTIFICATION OF COMPLETION

- A. Engineer shall perform confirmatory sampling and then either instruct the Contractor to perform additional abatement work or that abatement is complete for that area.
- B. The Contractor shall then remove all containment equipment, decontamination facilities and other temporary structures and clean the work area of any dust or other debris from the abatement work performed by the Contractor. The Contractor is responsible for restoring the work area as discussed in Section 3.09 and other areas of the Contract Documents.

3.07 DISPOSAL OF PCB-CONTAINING MATERIALS

- A. The Contractor shall obtain final signed waste manifests and certified tare and gross weight slips for each load received at the disposal facilities for PCB bulk product wastes and provide to the Engineer and Owner within 21 days of obtaining final signed manifests.
- B. All PCB waste shall be carefully loaded into roll-off containers and onto trucks or

other appropriate vehicles for transport. Before and during transport, care shall be exercised to ensure that no unauthorized persons have access to the material. All transportation vehicles shall be appropriately placarded in accordance with 40 CFR Part 761.

- C. Transporters of the waste are prohibited from “back hauling” any freight after the disposition of the Owner’s waste stream until decontamination of the vehicle and/or trailer is completed.

3.08 WASTE MANAGEMENT AND DISPOSAL

- A. The Contractor shall be responsible for all packaging, labeling, transporting, disposal, and record-keeping associated with PCB bulk product waste in accordance with all Federal, State and local regulations.
- B. The Contractor shall prepare and submit to the Engineer for review all waste profile applications and questionnaires, and coordinate with disposal facilities.
- C. The Owner shall obtain an EPA Manifest Identification Number prior to the performance of the work and provide to the Contractor.
- D. The Contractor shall prepare all Hazardous Waste Manifests. The Owner shall provide a representative to sign all Manifests unless a “Duly Authorized Agent” agreement is established between the Owner and the Contractor.
- E. The Contractor is responsible for determining that all personnel transporting the waste holds a valid permit and license issued in accordance with appropriate Federal, State, and local regulations.
- F. The Contractor shall provide to the transporter at the time of transfer appropriate shipping records as required by the Federal, State and local regulations with a copy to the Engineer.
- G. The Contractor shall furnish all generator copies of the Hazardous Waste Manifests to the Owner for submittal to the appropriate regulatory agencies and to retain for the Owner’s records.
- H. Contractor shall maintain proper follow up procedures to determine that waste materials have been received by the designated disposal facility in a timely manner and in accordance with all Federal, State and local regulations.
- G. The Contractor shall submit to the Engineer, prior to receiving progress payment, documentation certifying that all materials were transported to, accepted, and disposed of, at the selected disposal facility (ies). The documentation shall include the following, as a minimum.

1. Documentation shall be provided for each load from the site to the disposal facility, including all manifests and any other transfer documentation as applicable.
2. All documentation for each load shall be tracked by the original manifest document number that was assigned by the Engineer at the site.
3. All ORIGINAL signatures (including signatures of Owner and disposal facility's representative) associated with shipment of any material from the Site within 21 days of obtaining the final signature.

3.09 RESTORATION

- A. The Engineer shall instruct the Abatement and General Contractor when abatement is complete within each PCB abatement area based upon confirmatory sample results. The Abatement Contractor shall remove temporary decontamination facilities, temporary enclosures, and clean the PCB abatement area to remove any accumulated materials or dust.
- B. The General Contractor shall be responsible for restoration of areas following abatement.
 - a. General Contractor shall install mechanical equipment as indicated in the project documents.
 - b. General Contractor shall paint walls where PCB-containing paints were abated as per the requirements of the applicable Sections.

END OF SECTION



TATTVAM ENVIRONMENTAL AND ENGINEERING SOLUTIONS, LLC

Asbestos Inspection Report
Cider Mill Pump Station,
Glastonbury, CT

prepared for:

Wright-Pierce
169 Main Street,
Middletown, CT 06457

August 14th, 2017

Tattvam HAZMAT Project # 17-063

Table of Contents

Asbestos Inspection Report

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Introduction

On July 25th, 2017, Tattvam Environmental collected samples of selected materials suspected to be Asbestos Containing Materials (ACM) at the Cider Mill Pump Station located at Glastonbury, CT

Asbestos Inspection

The asbestos inspection was limited and addressed specific materials to be impacted by renovation as requested by Wright Pierce. One sample was collected from the site.

Results

The collected sample and chain of custody form was sent to a State of Connecticut-licensed asbestos analytical laboratory for analysis by Polarized Light Microscopy (PLM). The sampling locations, material type, sample identification, and asbestos content are identified in Table below.

Asbestos-Containing Materials

Sample No.	Location	Material Type	Asbestos Content
1	Cylinder	Gasket	None Detected

The gasket at the cylinder is not an Asbestos Containing Material.

SanAir Technologies Laboratory

Analysis Report

prepared for

**Tattvam Environmental And
Engineering Solutions**

Report Date: 8/2/2017
Project Name: Cider Mill - PS
SanAir ID#: 17028289



NVLAP LAB CODE 200870-0



Certification # 652931



License # LAB0166



804.897.1177

www.sanair.com



SanAir Technologies Laboratory, Inc.

1551 Oakbridge Drive, Suite B, Powhatan, VA 23139
804.897.1177 Toll Free: 888.895.1177 Fax: 804.897.0070
Web: <http://www.sanair.com> E-mail: iaq@sanair.com

**Tattvam Environmental And Engineering Solutions
11 Park Lane
Trumbull, CT 06611**

August 2, 2017

SanAir ID # 17028289
Project Name: Cider Mill - PS
Project Number:

Dear Indu Nambiar,

We at SanAir would like to thank you for the work you recently submitted. The 1 sample(s) were received on Wednesday, July 26, 2017 via FedEx. The final report(s) is enclosed for the following sample(s): 1.

These results only pertain to this job and should not be used in the interpretation of any other job. This report is only complete in its entirety. Refer to the listing below of the pages included in a complete final report.

Sincerely,

Sandra Sobrino
Asbestos & Materials Laboratory Manager
SanAir Technologies Laboratory

Final Report Includes:

- Cover Letter
- Analysis Pages
- Disclaimers and Additional Information

sample conditions:

1 sample(s) in Good condition



SanAir Technologies Laboratory, Inc.

1551 Oakbridge Drive, Suite B, Powhatan, VA 23139
804.897.1177 Toll Free: 888.895.1177 Fax: 804.897.0070
Web: <http://www.sanair.com> E-mail: iaq@sanair.com

SanAir ID Number

17028289

FINAL REPORT

Name: Tattvam Environmental And Engineering
Address: Solutions
11 Park Lane
Trumbull, CT 06611


Project Number:
P.O. Number:
Project Name: Cider Mill - PS

Collected Date: 7/25/2017
Received Date: 7/26/2017 10:10:00 AM
Report Date: 8/2/2017 3:27:22 PM
Analyst: Steiner, Tara

Asbestos Bulk PLM EPA 600/R-93/116

SanAir ID / Description	Stereoscopic Appearance	Components		Asbestos Fibers
		% Fibrous	% Non-Fibrous	
1 / 17028289-001 Gasket @ Cylinder	Black Non-Fibrous Homogeneous		100% Other	None Detected

Certification

Analyst: 
Analysis Date: 8/2/2017

Approved Signatory: 
Date: 8/2/2017

Disclaimer

The final report cannot be reproduced, except in full, without written authorization from SanAir. Fibers smaller than 5 microns cannot be seen with this method due to scope limitations. The accuracy of the results is dependent upon the client's sampling procedure and information provided to the laboratory by the client. SanAir assumes no responsibility for the sampling procedure and will provide evaluation reports based solely on the sample and information provided by the client. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government.

For NY state samples, method EPA 600/M4-82-020 is performed.

Polarized- light microscopy is not consistently reliable in detecting asbestos in floor covering and similar non-friable organically bound materials. Quantitative transmission electron microscopy is currently the only method that can be used to determine if this material can be considered or treated as non-asbestos containing.

NY ELAP lab ID 11983



1551 Oakbridge Dr. STE B
 Powhatan, VA 23139
 804.897.1177 / 888.895.1177
 Fax 804.897.0070
 sanair.com

Asbestos
 Chain of Custody
 Form 140, Rev 1, 1/20/2017

SanAir ID Number
 17028289

Company: Tattvam Environmental And Engineering Solutions		Project #:	Collect by: <i>Tattvam Environ</i>
Address: 11 Park Lane		Project Name: <i>Gaskets - Mill - PS</i>	Phone #: 203-880-9767
City, St, Zip: Trumbull, CT 06611		Date Collected: <i>7/25</i>	Fax #: 203-880-4024
State of Collection: <i>CT</i>	Account#: 2624	P.O. Number:	Email: <i>inclu@tattvameng.com</i>

Bulk		Air		Soil	
ABB	PLM EPA 600/R-93/116 <input checked="" type="checkbox"/>	ABA	PCM NIOSH 7400 <input type="checkbox"/>	ABSE	PLM EPA 600/R-93/116 (Qual.) <input type="checkbox"/>
	Positive Stop <input type="checkbox"/>	ABA-2	OSHA w/ TWA* <input type="checkbox"/>	Vermiculite & Soil	
ABEPA	PLM EPA 400 Point Count <input type="checkbox"/>	ABTEM	TEM AHERA <input type="checkbox"/>	ABSP	PLM CARB 435 (LOD <1%) <input type="checkbox"/>
ABBIK	PLM EPA 1000 Point Count <input type="checkbox"/>	ABATN	TEM NIOSH 7402 <input type="checkbox"/>	ABSPI	PLM CARB 435 (LOD 0.25%) <input type="checkbox"/>
ABBN	PLM EPA NOB** <input type="checkbox"/>	ABT2	TEM Level II <input type="checkbox"/>	ABSP2	PLM CARB 435 (LOD 0.1%) <input type="checkbox"/>
ABBCH	TEM Chatfield** <input type="checkbox"/>	Other:	<input type="checkbox"/>	Dust	
ABBTM	TEM EPA NOB** <input type="checkbox"/>	New York ELAP		ABWA	TEM Wipe ASTM D-6480 <input type="checkbox"/>
ABQ	PLM Qualitative <input type="checkbox"/>	PLM NY	PLM EPA 600/M4-82-020 <input type="checkbox"/>	ABDMV	TEM Microvac ASTM D-5755 <input type="checkbox"/>
		ABEPA2	NY ELAP 198.1 <input type="checkbox"/>	Matrix Other	
Water		ABENY	NY ELAP 198.6 PLM NOB <input type="checkbox"/>		
ABHE	EPA 100.2 <input type="checkbox"/>	ABBNY	NY ELAP 198.4 TEM NOB <input type="checkbox"/>		

** Available on 24-hr. to 5-day TAT

Turn Around Times	3 HR (4 HR TEM) <input type="checkbox"/>	6 HR (8HR TEM) <input type="checkbox"/>	12 HR <input type="checkbox"/>	24 HR <input type="checkbox"/>
	<input type="checkbox"/> 2 Days	<input type="checkbox"/> 3 Days	<input type="checkbox"/> 4 Days	<input type="checkbox"/> 5 Days

Special Instructions

Sample #	Sample Identification/Location	Volume or Area	Sample Date	Flow Rate*	Start - Stop Time*
①	<i>Gasket @ Gaskets</i>				

Relinquished by	Date	Time	Received by	Date	Time
<i>Inch</i>	<i>7/25</i>		<i>MC</i>	<i>JUL 26 2017</i>	<i>10:00 AM</i>

If no technician is provided, then the primary contact for your account will be selected. Unless scheduled, the turnaround time for all samples received after 3 pm EST Friday will begin at 8 am Monday morning. Weekend or holiday work must be scheduled ahead of time and is charged for rush turnaround time. SanAir covers Standard Overnight FedEx shipping. Shipments billed to SanAir with a faster shipping rate will result in additional charges.

17028289

Maria E. Coker

From: Jordan L. Ridgeway
Sent: Wednesday, July 26, 2017 11:26 AM
To: Cheyenne E. Urbine; Maria E. Coker
Subject: FW: Cider Mill PS - Missing Turn-Around Time

Jordan Ridgeway
Account Executive
SanAir Technologies Laboratory, Inc
1551 Oakbridge Drive, Suite B
Powhatan, Va 23139
Phone: 804.897.1177
Phone: 888.895.1177
Fax 804.897.0070



www.sanair.com

"The Identification Specialists"

Asbestos, Environmental Microbiology, Legionella, Materials Testing

The information transmitted herewith is sensitive information intended only for use to the individual or entity to which it is addressed. If the reader of this message is not the intended recipient, you are hereby notified that any review, retransmission, dissemination, distribution, copying or other use of, or taking of any action in reliance upon, this information is strictly prohibited. If you have received this communication in error, please contact the sender and delete the material from your computer.

From: Indu Nambiar [mailto:indu@tattvamgroup.com]
Sent: Wednesday, July 26, 2017 11:25 AM
To: Jordan L. Ridgeway <jridgeway@sanair.com>
Subject: Re: Cider Mill PS - Missing Turn-Around Time

5-day turnaround please

Indu Nambiar
Environmental Engineer
www.tattvamgroup.com
Phone: 203 880 9767

On Wed, Jul 26, 2017 at 11:24 AM, Jordan L. Ridgeway <jridgeway@sanair.com> wrote:

RE: Cider Mill PS

SanAir #17028289

17028289

Hello,

What turn-around time would you like for this sample?

Jordan Ridgeway

Account Executive

SanAir Technologies Laboratory, Inc

1551 Oakbridge Drive, Suite B

Powhatan, Va 23139

Phone: 804.897.1177

Phone: 888.895.1177

Fax 804.897.0070



www.sanair.com

“The Identification Specialists”

Asbestos, Environmental Microbiology, Legionella, Materials Testing

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<http://www.everycloudtech.com/mail>



TATTVAM ENVIRONMENTAL AND ENGINEERING SOLUTIONS, LLC

Lead Based Paint Screening Report

Cider Mill Pump Station,
Glastonbury, CT

prepared for:

Wright-Pierce
169 Main Street,
Middletown, CT 06457

August 14th, 2017

Tattvam HAZMAT Project # 17-063

Table of Contents

Lead Based Paint Report

Introduction	3
Lead Based Paint Inspection.....	3
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Laboratory Results Appended	

Introduction

On July 25th, 2017, Tattvam Environmental collected samples of suspected lead based paint at the Cider Mill Pump Station located at Glastonbury, CT

Lead Based Paint Inspection

Lead Based Screening was conducted at the Cider Mill Pump Station. Five (5) paint chip samples were collected and sent to the State of Connecticut Licensed Laboratory.

Results

There was no lead detected in the samples collected.



Client: Ms. Indu Nambiar
Tattvam Environmental
11 Park Lane
Trumbull, CT 06611

Analytical Report

CET# 7070567

Report Date: July 28, 2017
Project: Cider Mill PS, Glastonbury

Connecticut Laboratory Certificate: PH 0116
Massachusetts laboratory Certificate: M-CT903



New York NELAP Accreditation: 11982
Rhode Island Certification: 199

CET # : 7070567

Project: Cider Mill PS, Glastonbury

SAMPLE SUMMARY

The sample(s) were received at 28.3°C.

This report contains analytical data associated with following samples only.

Sample ID	Laboratory ID	Matrix	Collection Date/Time	Receipt Date
1 Yellow/Green	7070567-01	Solid	7/25/2017	07/26/2017
2 Silver	7070567-02	Solid	7/25/2017	07/26/2017
3 Blue	7070567-03	Solid	7/25/2017	07/26/2017
4 Light Brown	7070567-04	Solid	7/25/2017	07/26/2017
5 Dark Brown	7070567-05	Solid	7/25/2017	07/26/2017

Analyte: Total Lead [EPA 6010C]

Analyst: CD

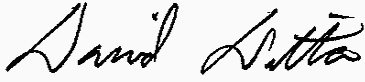
Matrix: Solid

Laboratory ID	Client Sample ID	Result	RL	Units	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
7070567-01	1 Yellow/Green	ND	0.10	%	1	B7G2731	07/27/2017	07/27/2017 15:54	
7070567-02	2 Silver	ND	0.10	%	1	B7G2731	07/27/2017	07/27/2017 15:58	
7070567-03	3 Blue	ND	0.10	%	1	B7G2731	07/27/2017	07/27/2017 16:03	
7070567-04	4 Light Brown	ND	0.10	%	1	B7G2731	07/27/2017	07/27/2017 16:07	
7070567-05	5 Dark Brown	ND	0.10	%	1	B7G2731	07/27/2017	07/27/2017 16:11	

All questions related to this report should be directed to David Ditta, Timothy Fusco, or Robert Blake at 203-377-9984.

Sincerely,

This technical report was reviewed by Timothy Fusco



David Ditta
Laboratory Director



Project Manager

Report Comments:

Sample Result Flags:

- E- The result is estimated, above the calibration range.
- H- The surrogate recovery is above the control limits.
- L- The surrogate recovery is below the control limits.
- B- The compound was detected in the laboratory blank.
- P- The Relative Percent Difference (RPD) of dual column analyses exceeds 40%.
- D- The RPD between the sample and the sample duplicate is high. Sample Homogeneity may be a problem.
- + - The Surrogate was diluted out.
- *C1- The Continuing Calibration did not meet method specifications and was biased low for this analyte. Increased uncertainty is associated with the reported value which is likely to be biased low.
- *C2- The Continuing Calibration did not meet method specifications and was biased high for this analyte. Increased uncertainty is associated with the reported value which is likely to be biased high.
- *F1- The Laboratory Control Sample recovery is outside of control limits. Reported value for this analyte is likely to be biased on the low side.
- *F2- The Laboratory Control Sample recovery is outside of control limits. Reported value for this analyte is likely to be biased on the high side.
- I- The Analyte exceeds %RSD limits for the Initial Calibration. This is a non-directional bias.

All results met standard operating procedures unless indicated by a data qualifier next to a sample result, or a narration in the QC report.

For Percent Solids, if any of the following prep methods (3050B, 3540C, 3545A, 3550C, 5035 and 9013A) were used for samples pertaining to this report, the percent solids procedure is within that prep method.

Complete Environmental Testing is only responsible for the certified testing and is not directly responsible for the integrity of the sample before laboratory receipt.

ND is None Detected at or above the specified reporting limit

RL is the Reporting Limit.

All analyses were performed in house unless a Reference Laboratory is listed.

Samples will be disposed of 30 days after the report date.

CET # : 7070567

Project: Cider Mill PS, Glastonbury

CERTIFICATIONS

Certified Analyses included in this Report

Analyte **Certifications**

EPA 6010C in Solid

Lead CT

Complete Environmental Testing operates under the following certifications and accreditations:

Code	Description	Number	Expires
CT	Connecticut Public Health	PH0116	09/30/2018



TATTVAM ENVIRONMENTAL AND ENGINEERING SOLUTIONS, LLC

**Polychlorinated Biphenyls (PCBs)
Inspection Report
Cider Mill Pump Station,
Glastonbury, CT**

prepared for:

Wright-Pierce
169 Main Street,
Middletown, CT 06457

August 15th, 2017

Tattvam HAZMAT Project # 17-063

Table of Contents

PCB Inspection Report

Introduction	3
PCB Inspection	3
Results	3
Laboratory Results Appended	

Introduction

On July 25th, 2017, Tattvam Environmental collected samples of selected materials suspected to contain Polychlorinated Biphenyls (PCBs) at the Cider Mill Pump Station located at Glastonbury, CT

Polychlorinated Biphenyls (PCBs) Bulk Sample Analysis

Sampling of PCBs is not mandated by the United States Environmental Protection Agency (US EPA) nor the State of Connecticut Department of Energy and Environmental Protection (CTDEEP), however, the compound PCB or any item, product or material containing the compound PCB cannot be disposed without following the US EPA Regulations and CTDEEP Statutes.

Background

US-EPA Regulations

These regulations apply if PCBs are present in concentrations above a specified level. Presently, PCB-containing materials at concentrations equal to or greater than (\geq) 50 ppm, or equivalent units of milligrams per kilogram (mg/kg) are regulated. The USEPA also regulates soil and adjacent substrate materials contaminated by the source materials greater than or equal to 50 ppm if the soil or substrates contain greater than 1 ppm PCB.

CT-DEEP Statutes

The CT-DEEP Statutes require the removal and disposal of source materials, soil, or substrate materials with PCB concentrations greater than 1 ppm.

Source Sampling

PCB bulk samples of building materials for PCB analysis were collected July 25th 2017. Sampling involved removal of bulk product materials (source materials) using hand tools to submit in bulk form to determine PCB content. Each sample was placed in an individual container, labeled, and delivered to Complete Environmental Testing, Inc. of Stratford, Connecticut using proper chain of custody. The analytical method for analysis included extraction method 3540C (Soxhlet) and analysis method SW-846 8082.

Cider Mill Pump Station					
Sample number	Location	Description	Results ppm	Federal /State	Specification
#1	Exterior	Dark Brown Paint	ND	N/A	
#2	Cylinder	Yellow and Green Paint	86	Federal	To be disposed at regulated site
#3	Harness Holder	Brown Paint	46	State	Remove and dispose per CT DEEP Regulations.
#4	Interior -Equipment	Blue Paint			
#5	Interior- Equipment and Floor	Silver gray paint			



Client: Ms. Indu Nambiar
Tattvam Environmental
11 Park Lane
Trumbull, CT 06611

Analytical Report

CET# 7070524

Report Date: July 31, 2017
Project: Cider Mill PS, Glastonbury

Connecticut Laboratory Certificate: PH 0116
Massachusetts laboratory Certificate: M-CT903



New York NELAP Accreditation: 11982
Rhode Island Certification: 199

CET # : 7070524

Project: Cider Mill PS, Glastonbury

SAMPLE SUMMARY

The sample(s) were received at 23.8°C.

This report contains analytical data associated with following samples only.

Sample ID	Laboratory ID	Matrix	Collection Date/Time	Receipt Date
Brown Paint Ext	7070524-01	Paint Chip	7/25/2017	07/25/2017
Yellow/Green Wall Combo	7070524-02	Paint Chip	7/25/2017	07/25/2017
3-5 Composite	7070524-03	Paint Chip	7/25/2017	07/25/2017

Client Sample ID Brown Paint Ext

Lab ID: 7070524-01

PCBs by Soxhlet

Analyst: JTS

Method: EPA 8082A

Matrix: Paint Chip

Analyte	Result (mg/kg (As Rec))	RL (mg/kg (As Rec))	Dilution	Prep Method	Batch	Prepared	Date/Time Analyzed	Notes
PCB-1016	ND	0.40	4	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:02	
PCB-1221	ND	0.40	4	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:02	
PCB-1232	ND	0.40	4	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:02	
PCB-1242	ND	0.40	4	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:02	
PCB-1248	ND	0.40	4	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:02	
PCB-1254	ND	0.40	4	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:02	
PCB-1260	ND	0.40	4	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:02	
PCB-1268	ND	0.40	4	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:02	
PCB-1262	ND	0.40	4	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:02	
<i>Surrogate: TCMX [1C]</i>	<i>63.0 %</i>	<i>30 - 150</i>			B7G2627	07/26/2017	07/28/2017 16:02	
<i>Surrogate: TCMX [2C]</i>	<i>54.5 %</i>	<i>30 - 150</i>			B7G2627	07/26/2017	07/28/2017 16:02	
<i>Surrogate: DCB [1C]</i>	<i>55.6 %</i>	<i>30 - 150</i>			B7G2627	07/26/2017	07/28/2017 16:02	
<i>Surrogate: DCB [2C]</i>	<i>53.0 %</i>	<i>30 - 150</i>			B7G2627	07/26/2017	07/28/2017 16:02	

CET # : 7070524

Project: Cider Mill PS, Glastonbury

Client Sample ID Yellow/Green Wall Combo

Lab ID: 7070524-02

PCBs by Soxhlet
Method: EPA 8082A

Analyst: JTS

Matrix: Paint Chip

Analyte	Result (mg/kg (As Rec))	RL (mg/kg (As Rec))	Dilution	Prep Method	Batch	Prepared	Date/Time Analyzed	Notes
PCB-1016	ND	20	200	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:21	
PCB-1221	ND	20	200	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:21	
PCB-1232	ND	20	200	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:21	
PCB-1242	89	20	200	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:21	
PCB-1248	ND	20	200	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:21	
PCB-1254	ND	20	200	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:21	
PCB-1260	ND	20	200	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:21	
PCB-1268	ND	20	200	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:21	
PCB-1262	ND	20	200	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:21	
<i>Surrogate: TCMX [1C]</i>	<i>94.9 %</i>		<i>30 - 150</i>		<i>B7G2627</i>	<i>07/26/2017</i>	<i>07/28/2017 16:21</i>	
<i>Surrogate: TCMX [2C]</i>	<i>71.7 %</i>		<i>30 - 150</i>		<i>B7G2627</i>	<i>07/26/2017</i>	<i>07/28/2017 16:21</i>	
<i>Surrogate: DCB [1C]</i>	<i>101 %</i>		<i>30 - 150</i>		<i>B7G2627</i>	<i>07/26/2017</i>	<i>07/28/2017 16:21</i>	
<i>Surrogate: DCB [2C]</i>	<i>99.5 %</i>		<i>30 - 150</i>		<i>B7G2627</i>	<i>07/26/2017</i>	<i>07/28/2017 16:21</i>	

CET # : 7070524

Project: Cider Mill PS, Glastonbury

Client Sample ID 3-5 Composite

Lab ID: 7070524-03

PCBs by Soxhlet
Method: EPA 8082A

Analyst: JTS

Matrix: Paint Chip

Analyte	Result (mg/kg (As Rec))	RL (mg/kg (As Rec))	Dilution	Prep Method	Batch	Prepared	Date/Time Analyzed	Notes
PCB-1016	ND	4.0	40	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:39	
PCB-1221	ND	4.0	40	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:39	
PCB-1232	ND	4.0	40	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:39	
PCB-1242	46	4.0	40	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:39	
PCB-1248	ND	4.0	40	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:39	
PCB-1254	ND	4.0	40	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:39	
PCB-1260	ND	4.0	40	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:39	
PCB-1268	ND	4.0	40	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:39	
PCB-1262	ND	4.0	40	EPA 3540C	B7G2627	07/26/2017	07/28/2017 16:39	
<i>Surrogate: TCMX [1C]</i>	<i>85.2 %</i>		<i>30 - 150</i>		<i>B7G2627</i>	<i>07/26/2017</i>	<i>07/28/2017 16:39</i>	
<i>Surrogate: TCMX [2C]</i>	<i>68.2 %</i>		<i>30 - 150</i>		<i>B7G2627</i>	<i>07/26/2017</i>	<i>07/28/2017 16:39</i>	
<i>Surrogate: DCB [1C]</i>	<i>79.4 %</i>		<i>30 - 150</i>		<i>B7G2627</i>	<i>07/26/2017</i>	<i>07/28/2017 16:39</i>	
<i>Surrogate: DCB [2C]</i>	<i>93.1 %</i>		<i>30 - 150</i>		<i>B7G2627</i>	<i>07/26/2017</i>	<i>07/28/2017 16:39</i>	

All questions related to this report should be directed to David Ditta, Timothy Fusco, or Robert Blake at 203-377-9984.

Sincerely,

This technical report was reviewed by Robert Blake



David Ditta
Laboratory Director



Project Manager

Report Comments:

Sample Result Flags:

- E- The result is estimated, above the calibration range.
- H- The surrogate recovery is above the control limits.
- L- The surrogate recovery is below the control limits.
- B- The compound was detected in the laboratory blank.
- P- The Relative Percent Difference (RPD) of dual column analyses exceeds 40%.
- D- The RPD between the sample and the sample duplicate is high. Sample Homogeneity may be a problem.
- + - The Surrogate was diluted out.
- *C1- The Continuing Calibration did not meet method specifications and was biased low for this analyte. Increased uncertainty is associated with the reported value which is likely to be biased low.
- *C2- The Continuing Calibration did not meet method specifications and was biased high for this analyte. Increased uncertainty is associated with the reported value which is likely to be biased high.
- *F1- The Laboratory Control Sample recovery is outside of control limits. Reported value for this analyte is likely to be biased on the low side.
- *F2- The Laboratory Control Sample recovery is outside of control limits. Reported value for this analyte is likely to be biased on the high side.
- I- The Analyte exceeds %RSD limits for the Initial Calibration. This is a non-directional bias.

All results met standard operating procedures unless indicated by a data qualifier next to a sample result, or a narration in the QC report.

For Percent Solids, if any of the following prep methods (3050B, 3540C, 3545A, 3550C, 5035 and 9013A) were used for samples pertaining to this report, the percent solids procedure is within that prep method.

Complete Environmental Testing is only responsible for the certified testing and is not directly responsible for the integrity of the sample before laboratory receipt.

ND is None Detected at or above the specified reporting limit

RL is the Reporting Limit.

All analyses were performed in house unless a Reference Laboratory is listed.

Samples will be disposed of 30 days after the report date.

CET # : 7070524

Project: Cider Mill PS, Glastonbury

CERTIFICATIONS

Certified Analyses included in this Report

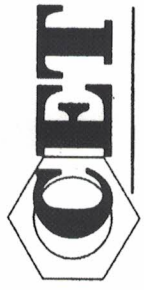
Analyte	Certifications
<i>EPA 8082A in Solid</i>	
PCB-1016	CT,NY
PCB-1221	CT,NY
PCB-1232	CT,NY
PCB-1242	CT,NY
PCB-1248	CT,NY
PCB-1254	CT,NY
PCB-1260	CT,NY
PCB-1268	CT
PCB-1262	CT

Complete Environmental Testing operates under the following certifications and accreditations:

Code	Description	Number	Expires
CT	Connecticut Public Health	PH0116	09/30/2018
NY	New York Certification (NELAC)	11982	04/01/2018



7070524



COMPLETE ENVIRONMENTAL TESTING, INC.

CHAIN OF CUSTODY

Volatile Soils Only:

Date and Time in Freezer

Client: **CET**

80 Lupes Drive
Stratford, CT 06615
Tel: (203) 377-9984
Fax: (203) 377-9952
e-mail: cet1@cetlabs.com
Bottle Request e-mail: bottleorders@cetlabs.com

Sample ID/Sample Depths
(include Units for any sample depths provided)

Brown paint extern - ①
Yellow/green soil combo - ②
Brown Tamars holder ③
Bluepart machin - ④
Floor equipment yellow ⑤
oomb

Collection Date/Time

7/25

Matrix
A-Air
S-Soil
W-Water
DW-Drinking Water
C-Cassette
Solid
Wipe
Other
(Specify)

Paint
↓
Combo

Turnaround Time **
(check one)

Same Day *
Next Day *
Two Day *
Three Day *
Std (5-7 Days)

8260 CT List
8260 Aromatics
8260 Halogens
CT ETPH
8270 CT List
8270 PNAS
PCBs SOX ASE
Pesticides

8 RCRA
13 Priority Poll
15 CT DEP
Total
SPLP
TCLP
Dissolved
Field Filtered
Lab to Filter

Additional Analysis

TOTAL # OF CONT.
NOTE #

NOTES:

PRESERVATIVE (Cl-HCl, N-HNO₃, S-H₂SO₄, Na-NaOH, C-Cool, O-Other)
CONTAINER TYPE (P-Plastic, G-Glass, V-Vial, O-Other)
Soil VOCs Only (M-MeOH B-Bisulfate W-Water F-Vial E-Encore)

RELINQUISHED BY: *[Signature]* DATE/TIME: 7/25/17 16:35
RECEIVED BY: *[Signature]* DATE/TIME: 7/25/17 16:35

RELINQUISHED BY: DATE/TIME: RECEIVED BY: DATE/TIME:

Client / Reporting Information

Company Name: **Tatavram Environmental**
Address: **11 Park Lane** City: **Stratford** State: **CT** Zip: **06611**
Report To: **Indu Nambiar** E-mail: **indu@tatavramgroup.com**
Phone #: **203 880 9767** Fax #: **203 880 9767**

Project Information

Project: **Welder-Mill P.S** PO #: _____
Location: **Glastonbury** Project #: _____
CET Quote #: _____ Collector(s): **Indu Nambiar**
QA/QC: Std Site Specific (MS/MSD) * RCP Pkg * DOAW *
Data Report: PDF EDD - Specify Format _____ Other _____
RSR Reporting Limits (check one) GA GB SWP Other _____
Laboratory Certification Needed (check one) CT NY RI MA
Temp Upon Receipt: **23.8°C** Evidence of Cooling: **Y** **(N)** PAGE _____ OF _____

* Additional charges may apply. ** TAT begins when the samples are received at the lab and all invoices are received. TAT is not applicable for samples received at the lab and all invoices are received.

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Engineering a Better Environment

