Project Manual for Contract No. 4 – Walnut Creek Wastewater Treatment Plant Improvements

ADEM ARPA CWSRF
PROJECT NO. CS010835-03

July 2025

Prepared for:
City of Troy
306 E Academy Street
Troy, Alabama 36081

Prepared by:

Three Notch Group
1962 West Main Street
Dothan, Alabama 36301

PROJECT MANUAL

FOR

Contract No. 4 – Walnut Creek Wastewater Treatment Plant Improvements

FUNDED BY

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
AMERICAN RESCUE PLAN ACT (ARPA) DRINKING WATER/WASTEWATER PROJECT
CWSRF Project No. CS010835-03

City of Troy

July 2025



Three Notch Group Project Number R021022458

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Contract No. 4 - Walnut Creek WWTP Improvements
City of Troy
Pike County, Alabama
CLIENT JOB NO. R021022458
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7/25/2025

DOCUMENT 00111

ADVERTISEMENT FOR BID

Owner: City of Troy
Locality: Troy, Alabama
Engineer: Three Notch Group, Inc.

City of Troy (Owner) is requesting Bids for the construction of the following Project:

Contract No. 4 - Walnut Creek Wastewater Treatment Plant Improvements
ADEM ARPA CWSRF Project No. CS010835-03

Bids for the construction of the Project will be received in person from properly licensed contractors at City Hall located at 301 Charles W. Meeks Avenue, Troy, Alabama 36081, until August 22, 2025, at 9:00 AM local time. At that time the Bids received will be publicly opened and read.

A mandatory Pre-Bid Meeting will be held at City Hall located at 301 Charles W. Meeks Avenue, Troy, Alabama 36081, on August 6, 2025, at 9:00 AM local time. Bids will only be accepted from bidders who attend the meeting.

The Project includes the following Work:

Construction of improvements to the existing Walnut Creek Wastewater Treatment Plant (WWTP) including replacement of influent lift station plug valve and base elbows, slide gate replacement at the grit chamber/oxidation ditch and clarifier splitter box, replacement of ultraviolet disinfection equipment, dewatering equipment improvements, tertiary filtration equipment and associated transfer pumps, and installation of an emergency standby generator with ATS and concrete pad.

The Owner requires the Project to be Substantially Completed within 330 Calendar days after the date when the Contract Time commences to run, and completed and ready for final payment within 360 Calendar days after the date when the Contract Time commences to run.

Copies of the Bidding Documents may be obtained from the Issuing Agent, Three Notch Group, Inc. (Ms. Kyndal Prescott - kyndal.prescott@3notch.com). Printed copies are available for a non-refundable fee in the amount of $150.00 per set. Copies in .pdf format are available via email at no cost to the bidder.

Partial sets of Bidding Documents will not be issued. Neither Owner nor Engineer will be responsible for full or partial sets of Bidding Documents, including addenda, if any, obtained from sources other than the Issuing Agent.

Bidders will be required to provide Bid security in the form of a Bid Bond or cashier's check in the amount of a sum no less than five (5) percent of the Bid Price but not more than $10,000.00.

The attention of bidders is called to the provisions of State Law Governing General Contractors, as set forth in Title 34, Chapter 8, Article 1, Code of Alabama of 1975, as amended; and the provisions of said law shall govern bidders insofar as it is applicable. The above-mentioned provisions of the Code make it illegal for the Owner to consider a bid from anyone who is not properly licensed under such code

provisions. In addition, bidders must carry the Municipal & Utility classification as listed in the latest edition of the Roster of the State Licensing Board for General Contractors, Montgomery, Alabama. The Owner will not consider any bid unless the bidder produces evidence that they are so licensed. All nonresident contractors preparing bids shall submit with their bid evidence of proper registration with the Alabama Secretary of State as a foreign corporation, and a Certificate of Good Standing as a Foreign Corporation from the State of Alabama Department of Revenue.

The attention of nonresident bidders is called to the provisions of Alabama Law, Title 39, Chapter 3, Code of Alabama 1975, as amended, whereby In the letting of public contracts in which any state, county, or municipal funds are utilized, except those contracts funded in whole or in part with funds received from a federal agency, preference shall be given to resident contractors, and a nonresident bidder domiciled in a state having laws granting preference to local contractors shall be awarded Alabama public contracts only on the same basis as the nonresident bidder's state awards contracts to Alabama contractors bidding under similar circumstances; resident contractors in Alabama, are to be granted preference over nonresidents in awarding of contracts in the same manner and to the same extent as provided by the laws of the state of domicile of the nonresident.

Issued by:

Owner: **City of Troy**
By: **Honorable Jason Reeves**
Title: **Mayor**

DOCUMENT 00200

INSTRUCTIONS TO BIDDERS

PART 1

1.1 SUMMARY

A. Document Includes:

- Bid submission
- Intent
- Definitions
- Availability of documents
- Examination of documents
- Inquiries and Addenda
- Product substitutions
- Site examination
- Prebid conference
- Bidder qualifications
- Bidder prequalification
- Subcontractors
- Submission procedure
- Bid ineligibility
- Security deposit
- Performance Assurance
- Bid Form requirements
- Bid Form signature
- Additional Bid information
- Selection and award of alternates
- Bid opening
- Duration of offer
- Acceptance of offer
- Laws and Regulations
- Certification of License

1.2 BID SUBMISSION

A. Bids signed, executed, and dated will be received by the Owner at the time and date as stipulated in the Invitation to Bid (Document 00105).

B. Bids submitted after the above time will be returned to Bidder unopened.

C. Amendments to submitted Bids will be permitted when received in writing prior to bid closing and when endorsed by the same party or parties who signed and sealed the Bid.

D. Bidders may withdraw their Bid any time before bid closing.

1.3 INTENT

A. The intent of this Bid request is to obtain an offer to perform work to complete the Project as detailed on the corresponding Plans and Specifications for a Unit Price contract in accordance with the Contract Documents.

B. In the case of a discrepancy between a unit bid price and the extension amount, the unit price shall govern. The sum of the extension amounts will be the contract bid price.

C. The unit price for any Additive Alternates or Deductive Alternates shall be the same as the corresponding unit price in the Base Bid.

1.4 DEFINITIONS

A. Bidding Documents: Contract Documents supplemented with Advertisement for Bids, Invitation to Bid, Instructions to Bidders, Information Available to Bidders, Bid Form, Bid Form Supplements and Appendices, and bid securities, identified.

B. Bid: Executed Bid Form and required attachments submitted in accordance with these Instructions to Bidders.

1.5 AVAILABILITY OF DOCUMENTS

A. Bidding Documents may be obtained as stated in Invitation to Bid.

B. Partial sets of Bidding Documents will not be issued.

C. Bidding Documents are made available only for the purpose of obtaining offers for this Project. Their use does not grant a license for other purposes.

1.6 EXAMINATION OF DOCUMENTS

A. Bidding Documents may be viewed at the office of the Engineer.

B. Upon receipt of Bidding Documents verify documents are complete. Notify Engineer if documents are incomplete.

C. Immediately notify Engineer upon finding discrepancies or omissions in Bidding Documents.

1.7 INQUIRIES AND ADDENDA

A. Direct questions in writing to the office of the Engineer.

B. Verbal answers are not binding on any party.

C. Submit questions not less than 2 days before date set for receipt of Bids. Replies will be made by Addenda.

D. Addenda may be issued during bidding period. Addenda will be sent to known Bidders. Addenda become part of the Contract Documents. Include resultant costs in the Bid Price.

E. Contractor is to indicate receipt of Addenda in Section 5 of the Bid Form (Document 00412).

1.8 PRODUCT SUBSTITUTIONS

A. Requests for Product substitutions may be permitted before execution of Agreement. Refer to Section 01600 for substitution procedures.

B. With each substitution request, provide sufficient information for Engineer to determine acceptability of proposed products.

C. In submission of substitutions to Products specified, Bidders shall include in their request, changes required in the Work, changes to Contract Time and Contract Price to accommodate such approved substitutions. Later claims by the Bidder for an addition to the Contract Time or Contract Price because of changes in Work necessitated by use of substitutions will not be considered.

D. Provide complete information on required revisions to other Work to accommodate each substitution, the value of additions to or reductions from the Bid Price, including revisions to other Work.

E. Provide Products as specified unless substitutions are submitted in this manner and subsequently accepted.

F. Bidder to compensate Engineer for time spent in review of proposed substitutions at the Engineer's standard charge-out rate.

G. Approval to submit substitution requests prior to submission of Bids is not required.

1.9 SITE EXAMINATION

A. Examine Project site before submitting a Bid.

B. Contact Owner to arrange date and time to visit Project site.

1.10 PREBID CONFERENCE

A. If a prebid conference is scheduled it will take place on the date, time and location as referenced in the Invitation to Bid.

B. Representatives of the Owner and the Engineer will be in attendance.

C. Summarized minutes of this meeting will be circulated to attendees. These minutes will not form part of Contract Documents.

D. Information relevant to Bidding Documents will be issued by Addendum.

1.11 BIDDER QUALIFICATIONS

A. To demonstrate qualification for performing Work of this Contract, Bidders may be requested to submit written evidence of financial position, previous experience with Work of similar scope and magnitude to that of this Contract, current commitments, and license to perform work in the State of Alabama. Additionally, the Owner or Engineer may contact references to investigate the Bidder's successful completion of Work of similar scope and magnitude.

1.12 BIDDER PREQUALIFICATION

A. When specifically requested, complete and submit the prequalification form provided to Engineer on or before date referenced in the Invitation to Bid.

B. Unless stated otherwise in the Invitation to Bid, Owner will provide written notice of pre-qualification status within 10 days of deadline for submission of pre-qualification statement.

1.13 SUBCONTRACTORS

A. The Owner reserves the right to reject a proposed Subcontractor for reasonable cause.

B. The General Contractor may not utilize Subcontractors to perform more than 30% of the total Project.

C. Refer to the General Conditions Section 00700 - Articles 1 and 6.

1.14 SUBMISSION PROCEDURE

A. Bidders shall be solely responsible for delivery of Bids in manner and time prescribed.

B. Submit one copy of executed offer on Bid Forms provided, signed and sealed with required bid bond in a closed opaque envelope, clearly identified with Bidder's name, Project name, Alabama General Contractor's License number, and Owner's name on the outside.

C. Required documents to be included in the sealed envelope:
   1. Document 00410 – Bid Bond
   2. Document 00412 – Bid Form
   3. Document 00450 – Affidavit of Immigration Compliance with E-Verify Memorandum of Understanding.

D. Improperly completed information or irregularities in bid bond may be cause the Bid to be declared invalid or informal.

E. An abstract summary of submitted Bids will be made available to all Bidders following bid opening.

1.15 BID INELIGIBILITY

A. Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind, will be declared unacceptable at Owner's discretion.

B. Bid Forms, Appendices, and enclosures which are improperly prepared may be declared unacceptable at Owner's discretion.

C. Failure to provide security deposit, bonds or insurance requirements may invalidate the Bid at the discretion of the Owner.

1.16 SECURITY DEPOSIT

A. Bids shall be accompanied by security deposit as follows:
   1. Unless indicated otherwise in the Invitation to Bid, a Bid Bond shall be provided in the amount of a sum no less than five (5) percent of the bid price but not exceeding $10,000 on standard surety company form.

   2. A certified check in the amount listed above will be accepted in place of a bid bond.

B. Security deposit of accepted Bidder will be returned after delivery to the Engineer of the required Performance and Payment Bonds by the accepted Bidder.

C. Include the cost of security deposit in the Bid Price.

D. After a Bid has been accepted, security deposits will be returned to the respective Bidders, upon request.

E. If no contract is awarded, security deposits will be returned.

1.17 PERFORMANCE ASSURANCE

A. Accepted Bidder: Provide a Performance and Payment bond as described in Document 00700 – General Conditions.

B. Include the cost of performance assurance bonds in the Bid Price.

1.18 BID FORM REQUIREMENTS

A. Complete requested information in the Bid Form and Bid Form Supplements.

B. Refer to Document 00700 – General Conditions for inclusion of taxes, procedures for tax rebate claims by the Owner and tax-exempt Products.

1.19 BID FORM SIGNATURE

A. Sign Bid Form, as follows:

1. Sole Proprietorship: Signature of sole proprietor in the presence of a witness who will also sign. Insert the words "Sole Proprietor" under the signature. [Affix seal.]
2. Partnership: Signature of all partners in the presence of a witness who will also sign. Insert the word "Partner" under each signature. [Affix seal to each signature.]
3. Corporation: Signature of duly authorized signing officers in their normal signatures. Insert the officer's capacity in which the signing officer acts, under each signature. Affix the corporate seal. If the Bid is signed by officials other than the president and secretary of the company, or the president/secretary/treasurer of the company, submit a copy of the by-law resolution of their board of directors authorizing them to do so, with the Bid Form in the bid envelope.
4. Joint Venture: Signature of each party of the joint venture under their respective seals in a manner appropriate to such party as described above, similar to requirements for Partnerships.

1.20 ADDITIONAL BID INFORMATION

A. **Each Bidder, and each Subcontractor, is required to complete and submit Document 00450 – Affidavit of Immigration Compliance along with their E-Verify Program Memorandum of Understanding at the time of the Bid. No Contract will be awarded to any Bidder who does not submit the required Immigration Compliance documents.**

1.21 SELECTION AND AWARD OF ALTERNATES

A. Bids will be evaluated on base Bid Price and awarded to the lowest responsive, responsible bidder. After determination of accepted Bidder, consideration will be given to alternates and Bid Price adjustments.

1.22 BID OPENING

A. Bids will be opened publicly immediately after time for receipt of Bids. Bidders may be present.

1.23 DURATION OF OFFER

A. Bids shall remain open to acceptance and shall be irrevocable for a period of 60 days after bid closing date.

1.24 ACCEPTANCE OF OFFER

A. The Owner reserves the right to accept or reject any or all offers.

B. After acceptance by the Owner, the Engineer on behalf of the Owner will issue to the accepted Bidder, a written Notice of Award.

C. Notwithstanding delay in the preparation and execution of the Agreement, accepted Bidder shall be prepared, upon written Notice to Proceed, to commence work within seven days following receipt of official written order of the Owner to proceed, or on date stipulated in such order.

DOCUMENT 00410

BID BOND

BIDDER (Name and Address):

_____

_____

_____

SURETY (Name and Address of Principal Place of Business):

_____

_____

_____

OWNER (Name and Address):

City of Troy

301 Charles W. Meeks Avenue

Troy, Alabama 36081

BID

BID DUE DATE: _____

PROJECT (Brief Description Including Location):

Contract No. 4 - Walnut Creek Wastewater Treatment Plant Improvements ADEM ARPA Project No. CS010835-03

Troy, Alabama

_____

BOND

BOND NUMBER: _____

DATE (Not later than Bid due date): _____

PENAL SUM: _____ _____

(Words) (Figures)

IN WITNESS WHEREOF, Surety and Bidder, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Bid Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

BIDDER	SURETY
_____(Seal)	_____(Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature and Title	Signature and Title (Attach Power of Attorney)
Attest: _____	Attest: _____
Signature and Title	Signature and Title

Note: (1) Above addresses are to be used for giving required notice.

(2) Any singular reference to Bidder, Surety, OWNER or other party shall be considered plural where applicable.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to pay to OWNER upon default of Bidder the penal sum set forth on the face of this Bond.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by OWNER) the executed Agreement required by the Bidding Documents and any performance and payment Bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

3.1. OWNER accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by OWNER) the executed Agreement required by the Bidding Documents and any performance and payment Bonds required by the Bidding Documents, or

3.2. All Bids are rejected by OWNER, or

3.3. OWNER fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default by Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from OWNER, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of and any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by OWNER and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent or representative who executed this Bond on behalf of Surety to execute, seal and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer or proposal as applicable.

END OF DOCUMENT

DOCUMENT 00412

BID FORM

To: **City of Troy**

Project: Contract No. 4 –Walnut Creek Wastewater Treatment Plant Improvements
ADEM ARPA Project Not. CS010835-**03**

Date: _____

Submitted by: _____
(full name)

(full address) _____

_____

1. OFFER

Having examined the Place of the Work and all matters referred to in the Instructions to Bidders and the Contract Documents prepared by the Engineer for the above-mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Unit Prices listed in this bid form in lawful money of the United States of America.

We have included the Bid Bond as required by the Instruction to Bidders.

All applicable federal and State of Alabama taxes are included in the Unit Prices.

Explanations of Bid Items are described in Section 01200 - Price and Payment Procedures.

2. ACCEPTANCE

This offer shall be open to acceptance and is irrevocable for sixty (60) days from the bid closing date.

If this bid is accepted by the Owner within the time period stated above, we will, unless otherwise allowed by the Owner:

- Execute the Agreement within seven (7) days of receipt of Notice of Award.
- Furnish the required bonds and insurance within fourteen (14) days of receipt of Notice of Award.
- Commence work within seven (7) days after written Notice to Proceed

If this bid is accepted within the time stated, and we fail to commence the Work, or we fail to provide the required bonds, the security deposit shall be forfeited as damages to the Owner by

reason of our failure, limited in amount to the lesser of the face value of the security deposit or the difference between this bid and the bid upon which a Contract is signed.
In the event our bid is not accepted within the time stated above, the required security deposit will be returned to the undersigned, in accordance with the provisions of the Instructions to Bidders; unless a mutually satisfactory arrangement is made for its retention and validity for an extended period of time.

3. CONTRACT TIME AND LIQUIDATED DAMAGES

If this Bid is accepted:

- The Work will be substantially completed in **three hundred and thirty (330)** calendar days from the Notice to Proceed.
- Liquidated damages of **$500.00** shall be paid by Contractor for each day beyond the agreed upon substantial completion date.

4. ADDENDA

The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Price.

Addendum No._____ Dated _____

Addendum No._____ Dated _____

5. BID FORM SIGNATURES

The Corporate Seal of

_____
(Bidder - print the full name of your firm)

was hereunto affixed in the presence of:

_____
(Authorized signing officer Title)

(Seal)

_____
(Authorized signing officer Title)

(Seal)

If the Bid is a joint venture or partnership, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

Bid Form
Contract No. 4 - Walnut Creek Wastewater Treatment Plant Improvements
ADEM ARPA Project No. CS010835-03
City of Troy

BASE BID

NO.	DESCRIPTION	UNIT	QTY	UNIT PRICE	EXTENSION PRICE
1.	Mobilization	LS	1	$	$
2.	Influent Lift Station Plug Valve and Base Elbow Replacement	EACH	1	$	$
3.	Filtration Equipment	LS	1	$	$
4.	Ultraviolet Disinfection Equipment Replacement	LS	1	$	$
5.	Dewatering Equipment Improvements	LS	1	$	$
				TOTAL BASE BID:	$

ADDITIVE ALTERNATE

NO.	DESCRIPTION	UNIT	QTY	UNIT PRICE	TOTAL PRICE
1.	Emergency Standby Generator with ATS	LS	1	$	$
2.	Influent Lift Station Rehabilitation	LS	1	$	$
3.	Oxidation Ditch Slide Gate Replacement	LS	1	$	$
4.	Clarifier Splitter Box Slide Gate Replacement	LS	1	$	$
5.	Septage/Grit Receiving Pit Rehabilitation	LS	1	$	$
6.	Clarifier Launder Covers	LS	1	$	$
7.	Out of Service Clarifier Rehabilitation	LS	1	$	$
8.	Tractor with Front-End Loader	LS	1	$	$
9.	Biosolids Spreader Truck	LS	1	$	$
10.	Water Jetting Trailer	LS	1	$	$

END OF DOCUMENT

DOCUMENT 00450

AFFIDAVIT OF IMMIGRATION COMPLIANCE

STATE OF _____

COUNTY OF _____

_____ being duly sworn deposes and says:
(print name)

1. I am over the age of twenty-one (21). I am employed as _____
(print title)

with _____
(print company name)

(hereinafter the "Company") who is a contractor, subcontractor, supplier, service provider or vendor with employees in the State of Alabama. In that capacity, I have personal knowledge of the facts stated in this Affidavit and a good faith belief that the Company is in compliance with the Immigration Reform and Control Act of 1986 and Beason-Hammon Alabama Taxpayer and Citizen Protection Act (hereinafter the "Act"). This Affidavit is given in connection with a good faith effort immigration compliance self review or an independent outside review, in accordance with the Immigration Reform and Control Act of 1986, of the Company's immigration compliance.

2. The Company has not and does not knowingly employ, hire for employment, or continue to employ any unauthorized aliens. Further, the Company has no reason to believe that it has employed, hired for employment, or continues to employ and unauthorized aliens. The Company hereby certifies that it has made a good faith effort in accordance with the Immigration Reform and Control Act of 1986 to verify the employment eligibility and identity of all current employees.

3. The Company is presently enrolled in the E-Verify Program and shall verify every employee that is required to be verified according to the Immigration Reform and Control Act of 1986 and the Act. Attached to this Affidavit is the E-Verify Program for Employment Verification Memorandum of Understanding establishing that the Company is enrolled in the E-Verify Program.

4. The Company has, in good faith, complied with the Act with respect to verifying that it has correctly completed an I-9 for each of its current employees and it is in compliance with the Immigration Reform and Control Act of 1986, as well as all other provisions of the Act.

5. The Company affirms that it is providing written notice to its contractors, subcontractors, suppliers, service providers or vendors (hereinafter referred to as "Subcontractors"), who are in any manner involved with the Company's Projects or Contracts in the State of Alabama, of their immigration compliance

obligations and will obtain from each Subcontractor and retain in its files, and Affidavit of Immigration Compliance with the attached E-Verify Program for Employment Verification Memorandum of Understanding establishing that the Subcontractor is enrolled in the E-Verify Program. If requested, the Company will make a copy of each Subcontractors Affidavit of Immigration Compliance available, or as may be required in any audit of the immigration compliance efforts of the Company.

I certify that the above **AFFIDAVIT OF IMMIGRATION COMPLIANCE** is true and correct to the best of my knowledge.

_____
(sign name)

STATE OF _____

COUNTY OF _____

I, the undersigned, Notary Public in and for said County in said State, hereby certify that

_____ who serves in the position of
(print name)

_____ for _____
(print title) (print company name)

has signed the foregoing instrument and who is known to me, acknowledged before me on this day that, being informed of the contents of the instrument, and with full authority, did execute the same voluntarily.

(SEAL)

_____
NOTARY PUBLIC

My Commission Expires: _____

END OF DOCUMENT

DOCUMENT 00500

AGREEMENT
BETWEEN OWNER AND CONTRACTOR
ON THE BASIS OF A STIPULATED PRICE

THIS AGREEMENT is by and between the **City of Troy** (hereinafter called OWNER) and _____ (hereinafter called CONTRACTOR).

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE 1 - WORK

1.01 CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents.

ARTICLE 2 - THE PROJECT

2.01 The Project for which the Work under the Contract Documents, may be the whole or only a part, is generally described as follows: **CONTRACT NO. 4 - WALNUT CREEK WASTEWATER TREATMENT PLANT IMPROVEMENTS ADEM ARPA CS010835-03**

ARTICLE 3 - ENGINEER

3.01 The Project has been designed by **Three Notch Group, Inc.** who is hereinafter called ENGINEER and who is to act as OWNER's representative, assume all duties and responsibilities, and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 - CONTRACT TIME

4.01 *Time of the Essence*

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

4.02 *Days to Achieve Substantial Completion and Final Payment*

A. The Work will be substantially completed within **three hundred and thirty (330) calendar days** after the date when the Contract Time commences to run as provided in paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with paragraph 14.07 of the General Conditions within **three hundred and sixty (360) calendar days** after the date when the Contract Time commences to run.

4.03 *Liquidated Damages*

A. CONTRACTOR and OWNER recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the Work is not completed within the Time specified in paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by OWNER if the Work is not completed on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty), CONTRACTOR shall pay OWNER **$500.00** for each day that expires after the time specified in paragraph 4.02 for Substantial Completion until the Work is substantially complete. After Substantial Completion, if CONTRACTOR shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER **$500.00** for each day that expires after the time specified in paragraph 4.02 for completion and readiness for final payment until the Work is completed and ready for final payment.

ARTICLE 5 - CONTRACT PRICE

5.01 OWNER shall pay CONTRACTOR for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the amounts determined pursuant to paragraph 5.01.A below:

A. For all Unit Price Work, an amount equal to the sum of the established unit price for each separately identified item of Unit Price Work times the estimated quantity of that item as indicated in the Bid Form (Document 00412):

TOTAL OF ALL UNIT PRICES_____

(use words)

As provided in paragraph 11.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by ENGINEER as provided in paragraph 9.08 of the General Conditions. Unit prices have been computed as provided in paragraph 11.03 of the General Conditions.

ARTICLE 6 - PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

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

6.02 *Progress Payments; Retainage*

A. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment on or about the 10th day of each month during performance of the Work as provided in paragraphs 6.02.A.1 and 6.02.A.2 below. All such payments will be measured by the schedule of values established in paragraph 2.07.A of the

General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements:

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as ENGINEER may determine or OWNER may withhold, in accordance with paragraph 14.02 of the General Conditions:

a. 95% of Work completed (with the balance being retainage). If the Work has been 50% completed as determined by ENGINEER, and if the character and progress of the Work have been satisfactory to OWNER and ENGINEER, OWNER, on recommendation of ENGINEER, may determine that as long as the character and progress of the Work remain satisfactory to them, there will be no additional retainage on account of Work subsequently completed, in which case the remaining progress payments prior to Substantial Completion will be in an amount equal to 100% of the Work completed less the aggregate of payments previously made; and

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

2. Upon Substantial Completion, OWNER shall pay an amount sufficient to increase total payments to CONTRACTOR to 97.5% of the Work completed, less such amounts as ENGINEER shall determine in accordance with paragraph 14.02.B.5 of the General Conditions and less 100% of ENGINEER's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected attached to the certificate of Substantial Completion.

6.03 *Final Payment*

A. Upon final completion and acceptance of the Work in accordance with paragraph 14.07 of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in said paragraph 14.07.

ARTICLE 7 - CONTRACTOR'S REPRESENTATIONS

7.01 In order to induce OWNER to enter into this Agreement CONTRACTOR makes the following representations:

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

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

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

D. CONTRACTOR has obtained and carefully studied (or assumes responsibility for having done so) all examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by CONTRACTOR, including applying the specific means, methods, techniques, sequences, and procedures of construction, if any, expressly required by the Contract Documents to be employed by CONTRACTOR, and safety precautions and programs incident thereto.

E. CONTRACTOR does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Time, and in accordance with the other terms and conditions of the Contract Documents.

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 correlated the information known to CONTRACTOR, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.

H. CONTRACTOR has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that CONTRACTOR has discovered in the Contract Documents, and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 8 - CONTRACT DOCUMENTS

8.01 *Contents*

A. The Contract Documents consist of the following:

1. CONTRACTOR's Bid;
2. Affidavit of Immigration Compliance;
3. This Agreement;
4. Notice of Award;
5. Documentation submitted by CONTRACTOR prior to Notice of Award;
6. Notice to Proceed;
7. Certificate by Owner;

8. Performance Bond;

9. Payment Bond;

10. Other Bonds;

    a. _____;

    b. _____;

11. General Conditions;

12. Drawings as listed on Cover Sheet Index bearing the Project name;

13. Addenda;

14. Technical specifications as listed in the Table of Contents and any appendices and/or attachments (if any) listed in the Table of Contents.

15. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:

    a. Written Amendments;

    b. Change Order(s).

B. The documents listed in paragraph 8.01.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 8.

D. The Contract Documents may only be amended, modified, or supplemented as provided in paragraph 3.04 of the General Conditions.

ARTICLE 9 - MISCELLANEOUS

9.01 *Terms*

A. Terms used in this Agreement will have the meanings indicated in the General Conditions.

9.02 *Assignment of Contract*

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

9.03 *Successors and Assigns*

A. OWNER and CONTRACTOR each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

9.04 *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.

IN WITNESS WHEREOF, OWNER and CONTRACTOR have signed this Agreement in duplicate. One counterpart each has been delivered to OWNER and CONTRACTOR. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR or on their behalf.

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

OWNER:	CONTRACTOR:
City of Troy	
By: _____	By: _____
[CORPORATE SEAL]	[CORPORATE SEAL]
Attest _____	Attest _____
Address for giving notices:	Address for giving notices:
301 Charles W. Meeks Avenue	_____
Troy, Alabama 36801	_____
(334) 566-0177	_____

END OF DOCUMENT

DOCUMENT 00510

NOTICE OF AWARD

Dated _____

TO _____
(BIDDER)

ADDRESS: _____

_____

PROJECT: **CONTRACT NO. 4 - WALNUT CREEK WASTEWATER TREATMENT PLANT IMPROVEMENTS ADEM ARPA CS010835-03**

You are notified that your Bid dated _____ for the above Contract has been considered. You are the apparent Successful Bidder and have been awarded a Contract for

_____
(Indicate total Work, alternates or sections or Work awarded)

The Contract Price of your Contract is

_____

Dollars ($_____).

Four (4) copies of the Agreement accompany this Notice of Award. Each copy of the Agreement and the Notice of Award must be executed and returned to the Engineer. Also enclosed are the requirements for Insurance and the Performance and Payment Bonds for this project.

You must comply with the following conditions precedent within 15 days of the date you receive this Notice of Award.

1. Deliver to the Engineer four (4) fully executed counterparts of all required Documents. Each of the Documents must bear original signatures.

2. Deliver with the executed Contract Documents the Contract security (Bonds) as specified in the Instructions to Bidders (Article 18), and General Conditions (paragraph 5.01).

3. (List other conditions precedent).

_____

_____

_____

_____

Failure to comply with these conditions within the time specified will entitle OWNER to consider your Bid in default, to annul this Notice of Award and to 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 Contract Documents.

City of Troy

By: _____
Honorable Jason Reeves, Mayor

Accepted By:

_____
(Contractor)

_____
(Authorized Signature)

_____
(Title)

END OF DOCUMENT

EJCDC No. 1910-22 (1996 Edition)
Prepared by the Engineers Joint Contract Documents Committee and endorsed by The Associated General Contractors of America and the Construction Specifications Institute.

DOCUMENT 00520

NOTICE TO PROCEED

DATE: _____

TO: _____
(CONTRACTOR)

ADDRESS: _____

_____

_____

Project: Contract No. 4 - Walnut Creek Wastewater Treatment Plant Improvements
ADEM ARPA Project No. CS10835-03
Project No. R021022458

You are notified that the Contract Time under the above contract will commence to run on _____. By that date, you are to start performing your obligations under the Contract Documents. In accordance with Article 3 of the Agreement, the date of Substantial Completion is _____ and the date of readiness for final payment is_____.

Before you may start any Work at the Site, paragraph 2.05.C of the General Conditions provides that you must deliver to the Owner (with copies to Engineer and other identified additional insured) certificates of insurance which you are required to purchase and maintain in accordance with the Contract Documents.

Also, before you may start any Work at the Site, you must
(add other requirements)

_____

City of Troy
(OWNER)

By: _____
Honorable Jason Reeves

Mayor
(TITLE)

Accepted By:

_____
(Contractor)

_____
(Authorized Signature)

_____
(Title)

END OF DOCUMENT

DOCUMENT 00530

CERTIFICATION BY OWNER

I, the undersigned, Jason Reeves, the duly authorized and acting official representative City of Troy do hereby certify as follows:

This contract was let in compliance with the Alabama Public Works Law and with all other applicable provisions of the law.

_____
Signature

Mayor
Title

_____
Date

END OF DOCUMENT

DOCUMENT 00610

PERFORMANCE BOND

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Address of Principal Place of Business):

OWNER (Name and Address):
City of Troy
301 Charles W. Meeks Avenue
Troy, Alabama 36081

CONTRACT

Date:
Amount: **$**
Description (Name and Location): **Contract No. 4 - Walnut Creek Wastewater Treatment Plant Improvements**
ADEM ARPA Project No. CS010835-03
Troy, Alabama

BOND

Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent or representative.

CONTRACTOR AS PRINCIPAL		**SURETY**	
Company:	(Corp. Seal)	Company:	(Corp. Seal)
Signature: _____		Signature: _____	
Name and Title:		Name and Title: (Attach Power of Attorney)	

(Space is provided below for signatures of additional parties, if required.)

CONTRACTOR AS PRINCIPAL		**SURETY**	
Company:	(Corp. Seal)	Company:	(Corp. Seal)
Signature: _____		Signature: _____	
Name and Title:		Name and Title:	

Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General Contractors of America, and the American Institute of Architects.

1. The CONTRACTOR and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Contract, which is incorporated herein by reference.

2. If the CONTRACTOR performs the Contract, the Surety and the CONTRACTOR have no obligation under this Bond, except to participate in conferences as provided in paragraph 3.1.

3. If there is no OWNER Default, the Surety's obligation under this Bond shall arise after:

3.1. The OWNER has notified the CONTRACTOR and the Surety at the addresses described in paragraph 10 below, that the OWNER is considering declaring a CONTRACTOR Default and has requested and attempted to arrange a conference with the CONTRACTOR and the Surety to be held not later than fifteen days after receipt of such notice to discuss methods of performing the Contract. If the OWNER, the CONTRACTOR and the Surety agree, the CONTRACTOR shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive the OWNER's right, if any, subsequently to declare a CONTRACTOR Default; and

3.2. The OWNER has declared a CONTRACTOR Default and formally terminated the CONTRACTOR's right to complete the Contract. Such CONTRACTOR Default shall not be declared earlier than twenty days after the CONTRACTOR and the Surety have received notice as provided in paragraph 3.1; and

3.3. The OWNER has agreed to pay the Balance of the Contract Price to:

3.3.1. The Surety in accordance with the terms of the Contract;

3.3.2 Another contractor selected pursuant to paragraph 4.3 to perform the Contract.

4. When the OWNER has satisfied the conditions of paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

4.1. Arrange for the CONTRACTOR, with consent of the OWNER, to perform and complete the Contract; or

4.2. Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or

4.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the OWNER for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by the OWNER and the contractor selected with the OWNER's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the Bonds issued on the Contract, and pay to the OWNER the amount of damages as described in paragraph 6 in excess of the Balance of the Contract Price incurred by the OWNER resulting from the CONTRACTOR Default; or

4.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances;

4.4.1 After investigation, determine the amount for which it may be liable to the OWNER and, as soon as practicable after the amount is determined, tender payment therefore to the OWNER; or

4.4.2 Deny liability in whole or in part and notify the OWNER citing reasons therefore.

5. If the Surety does not proceed as provided in paragraph 4 with reasonable promptness, the Surety shall be deemed to be in default on this Bond fifteen days after receipt of an additional written notice from the OWNER to the Surety demanding that the Surety perform its obligations under this Bond, and the OWNER shall be entitled to enforce any remedy available to the OWNER. If the Surety proceeds as provided in paragraph 4.4, and the OWNER refuses the payment tendered or the Surety has denied pliability, in whole or in part, without further notice the OWNER shall be entitled to enforce any remedy available to the OWNER.

6. After the OWNER has terminated the CONTRACTOR's right to complete the Contract, and if the Surety elects to act under paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the OWNER shall not be greater than those of the CONTRACTOR under the Contract, and the responsibilities of the OWNER to the Surety shall not be greater than those of the OWNER under the Contract. To a limit of the amount of this Bond, but subject to commitment by the OWNER of the Balance of the Contract Price to mitigation of costs and damages on the Contract, the Surety is obligated without duplication for:

6.1. The responsibilities of the CONTRACTOR for correction of defective Work and completion of the Contract;

6.2. Additional legal, design professional and delay costs resulting from the CONTRACTOR's Default, and resulting from the actions or failure to act of the Surety under paragraph 4; and

6.3. Liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of the CONTRACTOR.

7. The Surety shall not be liable to the OWNER or others for obligations of the CONTRACTOR that are unrelated to the Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the OWNER or its heirs, executors, administrators, or successors.

8. The Surety hereby waives notice of any change, including changes of time, to the Contract or to related subcontracts, purchase orders and other obligations.

9. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the Work or part of the Work is located and shall be instituted within two years after CONTRACTOR Default or within two years after the CONTRACTOR ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to the Surety, the OWNER or the CONTRACTOR shall be mailed or delivered to the address shown on the signature page.

11. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the Contract was be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted here from and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

12. The Performance Bond shall be reissued by the Contractor's Surety anytime the Contract amount is increased due to change order. The new Performance Bond shall be equal to the new Contract price as indicated in the Change Order and shall supersede all previous bonds issued.

13. Definitions.

13.1 Balance of the Contract Price: The total amount payable by the OWNER to the CONTRACTOR under the Contract after all proper adjustments have been made, including allowance to the CONTRACTOR of any amounts received or to be received by the OWNER in settlement of insurance or other Claims for damages to which the CONTRACTOR is entitled, reduced by all valid and proper payments made to or on behalf of the CONTRACTOR under the Contract.

13.2. Contract: The agreement between the OWNER and the CONTRACTOR identified on the signature page, including all Contract Documents and changes thereto.

13.3. CONTRACTOR Default: Failure of the CONTRACTOR, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.

13.4. OWNER Default: Failure of the OWNER, which has neither been remedied nor waived, to pay the CONTRACTOR as required by the Contract or to perform and complete or comply with the other terms thereof.

END OF DOCUMENT

DOCUMENT 00620

PAYMENT BOND

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Address of Principal Place of Business):

OWNER (Name and Address):
City of Troy
301 Charles W. Meeks Avenue
Troy, Alabama 36081

CONTRACT

Date:
Amount:
Description (Name and Location): **Contract No. 4 - Walnut Creek Wastewater Treatment Plant Improvements**
ADEM ARPA Project No. CS010835-03
Troy, Alabama

BOND

Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Payment Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	(Corp. Seal)	Company:	(Corp. Seal)
Signature: _____		Signature: _____	
Name and Title:		Name and Title: (Attach Power of Attorney)	

(Space is provided below for signatures of additional parties, if required.)

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	(Corp. Seal)	Company:	(Corp. Seal)
Signature: _____		Signature: _____	
Name and Title:		Name and Title:	

EJCDC No. 1910-28-B (1996 Edition)
Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General Contractors of America, the American Institute of Architects, the American Subcontractors Association, and the Associated Specialty Contractors.

1. The CONTRACTOR and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the OWNER to pay for labor, materials and equipment furnished for use in the performance of the Contract, which is incorporated herein by reference.

2. With respect to the OWNER, this obligation shall be null and void if the CONTRACTOR:

2.1. Promptly makes payment, directly or indirectly, for all sums due Claimants, and

2.2. Defends, indemnifies and holds harmless the OWNER from all claims, demands, liens or suits by any person or entity who furnished labor, materials or equipment for use in the performance of the Contract, provided the OWNER has promptly notified the CONTRACTOR and the Surety (at the addresses described in paragraph 12) of any claims, demands, liens or suits and tendered defense of such claims, demands, liens or suits to the CONTRACTOR and the Surety, and provided there is no OWNER Default.

3. With respect to Claimants, this obligation shall be null and void if the CONTRACTOR promptly makes payment, directly or indirectly, for all sums due.

4. The Surety shall have no obligation to Claimants under this Bond until:

4.1. Claimants who are employed by or have a direct contract with the CONTRACTOR have given notice to the Surety (at the addresses described in paragraph 12) and sent a copy, or notice thereof, to the OWNER, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

4.2. Claimants who do not have a direct contract with the CONTRACTOR:

1. Have furnished written notice to the CONTRACTOR and sent a copy, or notice thereof, to the OWNER, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed; and

2. Have either received a rejection in whole or in part from the CONTRACTOR, or not received within 30 days of furnishing the above notice any communication from the CONTRACTOR by which the CONTRACTOR had indicated the claim will be paid directly or indirectly; and

3. Not having been paid within the above 30 days, have sent a written notice to the Surety and sent a copy, or notice thereof, to the OWNER, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to the CONTRACTOR.

5. If a notice required by paragraph 4 is given by the OWNER to the CONTRACTOR or to the Surety, that is sufficient compliance.

6. When the Claimant has satisfied the conditions of paragraph 4, the Surety shall promptly and at the Surety's expense take the following actions:

6.1. Send an answer to the Claimant, with a copy to the OWNER, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.

6.2. Pay or arrange for payment of any undisputed amounts.

7. The Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

8. Amounts owed by the OWNER to the CONTRACTOR under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any Performance Bond. By the CONTRACTOR furnishing and the OWNER accepting this Bond, they agree that all funds earned by the CONTRACTOR in the performance of the Contract are dedicated to satisfy obligations of the CONTRACTOR and the Surety under this Bond, subject to the OWNER's priority to use the funds for the completion of the Work.

9. The Surety shall not be liable to the OWNER, Claimants or others for obligations of the CONTRACTOR that are unrelated to the Contract. The OWNER shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. The Surety hereby waives notice of any change, including changes of time, to the Contract or to related Subcontracts, purchase orders and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by paragraph 4.1 or paragraph 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the OWNER or the CONTRACTOR shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, the OWNER or the CONTRACTOR, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is, that this Bond shall be construed as a statutory Bond and not as a common law bond.

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, the CONTRACTOR shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. DEFINITIONS

15.1. Claimant: An individual or entity having a direct contract with the CONTRACTOR or with a Subcontractor of the CONTRACTOR to furnish labor, materials or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of the CONTRACTOR and the CONTRACTOR's Subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

15.2. Contract: The agreement between the OWNER and the CONTRACTOR identified on the signature page, including all Contract Documents and changes pthereto.

15.3. OWNER Default: Failure of the OWNER, which has neither been remedied nor waived, to pay the CONTRACTOR as required by the Contract or to perform and complete or comply with the other terms thereof.

END OF DOCUMENT

DOCUMENT 00700

GENERAL CONDITIONS

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GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Contract Documents and printed with initial or all capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof.

1. *Addenda*--Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the Contract Documents.

2. *Agreement*--The written instrument which is evidence of the agreement between OWNER and CONTRACTOR covering the Work.

3. *Application for Payment*--The form acceptable to ENGINEER which is to be used by CONTRACTOR during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*--Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*--The offer or proposal of a bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidding Documents*--The Bidding Requirements and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

7. *Bidding Requirements*--The Advertisement or Invitation to Bid, Instructions to Bidders, Bid security form, if any, and the Bid form with any supplements.

8. *Bonds*--Performance and payment bonds and other instruments of security.

9. *Change Order*--A document recommended by ENGINEER which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Time, issued on or after the Effective Date of the Agreement.

10. *Claim*--A demand or assertion by OWNER or CONTRACTOR seeking an adjustment of Contract Price or Contract Time, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*--The entire and integrated written agreement between the OWNER and CONTRACTOR concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*--The Contract Documents establish the rights and obligations of the parties and include the Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR's Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Notice to Proceed, the Bonds, these General Conditions, the Supplementary Conditions (if applicable), the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders, and ENGINEER's written interpretations and clarifications issued on or after the Effective Date of the Agreement. Approved Shop Drawings and the reports and drawings of subsurface and physical conditions are not Contract Documents. Only printed or hard copies of the items listed in this paragraph are Contract Documents. Files in electronic media format of text, data, graphics, and the like that may be furnished by OWNER to CONTRACTOR are not Contract Documents.

13. *Contract Price*--The moneys payable by OWNER to CONTRACTOR for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11.03 in the case of Unit Price Work).

14. *Contract Time*--The number of days or the dates stated in the Agreement to: (i) achieve Substantial Completion; and (ii) complete the Work

so that it is ready for final payment as evidenced by ENGINEER's written recommendation of final payment.

15. *CONTRACTOR*--The individual or entity with whom OWNER has entered into the Agreement.

16. *Cost of the Work*--See paragraph11.01A

17. *Drawings*--That part of the Contract Documents prepared or approved by ENGINEER which graphically shows the scope, extent, and character of the Work to be performed by CONTRACTOR. Shop Drawings and other CONTRACTOR submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*--The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. *ENGINEER*--The individual or entity named as such in the Agreement.

20. *ENGINEER's Consultant*--An individual or entity having a contract with ENGINEER to furnish services as ENGINEER's independent professional associate or consultant with respect to the Project.

21. *Field Order*--A written order issued by ENGINEER which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Time.

22. *General Requirements*--Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

23. *Hazardous Environmental Condition*--The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.

24. *Hazardous Waste*--The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

25. *Laws and Regulations; Laws or Regulations*--Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

26. *Liens*--Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

27. *Milestone*--A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

28. *Notice of Award*--The written notice by OWNER to the apparent successful bidder stating that upon timely compliance by the apparent successful bidder with the conditions precedent listed therein, OWNER will sign and deliver the Agreement.

29. *Notice to Proceed*--A written notice given by OWNER to CONTRACTOR fixing the date on which the Contract Time will commence to run and on which CONTRACTOR shall start to perform the Work under the Contract Documents.

30. *OWNER*--The individual, entity, public body, or authority with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be performed.

31. *Partial Utilization*--Use by OWNER of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

32. *PCBs*--Polychlorinated biphenyls.

33. *Petroleum*--Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

33A. *Products*—Materials and equipment that the Contractor furnishes and provides, other than labor and equipment.

34. *Project*--The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part as may be indicated elsewhere in the Contract Documents.

35. *Project Manual*--The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

36. *Radioactive Material*--Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

37. *Resident Project Representative*--The authorized representative of ENGINEER who may be assigned to the Site or any part thereof.

38. *Samples*--Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

39. *Shop Drawings*--All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate some portion of the Work.

40. *Site*--Lands or areas indicated in the Contract Documents as being furnished by OWNER upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by OWNER which are designated for the use of CONTRACTOR.

41. *Specifications*--That part of the Contract Documents consisting of written technical descriptions of materials, equipment, systems, standards, and workmanship as applied to the Work and certain administrative details applicable thereto.

42. *Subcontractor*--An individual or entity having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the Site.

43. *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.

44. *Supplementary Conditions*--That part of the Contract Documents which amends or supplements these General Conditions.

45. *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 any Subcontractor.

46. *Technical Data*—The specific times, locations, and depths/elevations identified in the reports and drawings contained in the Supplementary Conditions.

47. *Underground Facilities*--All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

48. *Unit Price Work*--Work to be paid for on the basis of unit prices.

49. *Work*--The entire completed construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

50. *Work Change Directive*--A written statement to CONTRACTOR issued on or after the Effective Date of the Agreement and signed by OWNER and recommended by ENGINEER ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the

Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Time but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Time.

51. *Written Amendment*--A written statement modifying the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the non-engineering or non-technical rather than strictly construction-related aspects of the Contract Documents.

1.02 *Terminology*

A. *Intent of Certain Terms or Adjectives*

1. Whenever in the Contract Documents the terms "as allowed," "as approved," or terms of like effect or import are used, or 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 action or determination will be solely to evaluate, in general, the completed Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed 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 shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.10 or any other provision of the Contract Documents.

B. *Day*

1. The word "day" shall constitute a calendar day of 24 hours measured from midnight to the next midnight.

C. *Defective*

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it does not conform to the Contract Documents or does not meet the requirements of any inspection, reference standard, test, or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER's recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with paragraph 14.04 or 14.05).

D. *Furnish, Install, Perform, Provide*

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of CONTRACTOR, "provide" is implied.

E. Unless stated otherwise in the Contract Documents, words or phrases which 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

A. When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds as CONTRACTOR may be required to furnish.

2.02 *Copies of Documents*

A. OWNER shall furnish to CONTRACTOR up to three copies of the Contract Documents. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Time; Notice to Proceed*

A. The Contract Time will commence on the date established in the Notice to Proceed and continue for the duration of the Project. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement.

2.04 *Starting the Work*

A. CONTRACTOR shall start to perform the Work on the date when the Contract Time commences to run. No Work shall be done at the Site prior to the date of the Notice to Proceed.

2.05 *Before Starting Construction*

A. *CONTRACTOR's Review of Contract Documents:* Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error, ambiguity, or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby; however, 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 knew or reasonably should have known thereof.

B. *Preliminary Schedules:* Within ten days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to ENGINEER for its timely review:

1. A preliminary progress schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. A preliminary schedule of Shop Drawing and Sample submittals which will list each required submittal and the times for submitting, reviewing, and processing such submittal; 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.

C. *Evidence of Insurance:* Before any Work at the Site is started, CONTRACTOR and OWNER shall each deliver to the other, with copies to each additional or named insured identified in Article 5, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which CONTRACTOR and OWNER respectively are required to purchase and maintain in accordance with Article 5.

2.06 *Preconstruction Conference*

A. Within 20 days after the Contract Time starts to run, but before any Work at the Site is started, a conference attended by CONTRACTOR, ENGINEER, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in paragraph 2.05.B, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

2.07 *Initial Acceptance of Schedules*

A. Unless otherwise provided in the Contract Documents, at least ten days before submission of the first Application for Payment a conference attended by CONTRACTOR, ENGINEER, and others as appropriate will be held to review for acceptability to ENGINEER as provided below the schedules submitted in accordance with paragraph 2.05.B. CONTRACTOR shall have an additional ten 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 any specified Milestones and the Contract Time. 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 therefore.

2. CONTRACTOR's schedule of Shop Drawing and Sample submittals will be acceptable to ENGINEER if it provides a workable arrangement for reviewing and processing the required submittals.

3. CONTRACTOR's schedule of values will be acceptable to ENGINEER as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to OWNER.

C. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER as provided in Article 9.

D. Sections of Division 1 – General Requirements govern the execution of the work of all sections of the specifications.

3.02 Reference Standards

A. *Standards, Specifications, Codes, Laws, and Regulations*

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or responsibilities of OWNER, CONTRACTOR, or ENGINEER, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall any such provision or instruction be effective to assign to OWNER, ENGINEER, or any of ENGINEER's Consultants, agents, or employees any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, CONTRACTOR shall report it to ENGINEER in writing at once. CONTRACTOR shall not proceed with the Work affected thereby (except in an emergency as required by paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in paragraph 3.04; provided, however, that CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity, or discrepancy unless CONTRACTOR knew or reasonably should have known thereof.

B. *Resolving Discrepancies*

1. The precedence for resolving discrepancies within the Contract Documents shall be as follows:

a. Stated dimensions shall govern over scaled dimensions unless determined to be obviously incorrect.

b. Plans shall govern over Specifications.

c. Special Provisions shall govern over Plans and Specifications.

2. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

a. The provisions of any standard, specification, manual, code, or instruction

(whether or not specifically incorporated by reference in the Contract Documents); or

b. The provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways: (i) a Written Amendment; (ii) a Change Order; or (iii) a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways: (i) a Field Order; (ii) ENGINEER's approval of a Shop Drawing or Sample; or (iii) ENGINEER's written interpretation or clarification.

3.05 *Reuse of Documents*

A. CONTRACTOR and any Subcontractor or Supplier or other individual or entity performing or furnishing any of the Work under a direct or indirect contract with OWNER: (i) shall not 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 ENGINEER's Consultant, including electronic media editions; and (ii) shall not reuse any of 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. This prohibition will survive final payment, completion, and acceptance of the Work, or termination or completion of the Contract. Nothing herein shall preclude CONTRACTOR from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

A. OWNER shall furnish the Site. OWNER shall notify CONTRACTOR of any encumbrances or restrictions not of general application but specifically related to use of the Site with which CONTRACTOR must comply in performing the Work. OWNER will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If CONTRACTOR and OWNER are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Time, or both, as a result of any delay in OWNER's furnishing the Site, CONTRACTOR may make a Claim therefore as provided in paragraph 10.05.

B. Upon reasonable written request, OWNER shall furnish CONTRACTOR with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and OWNER's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

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

1. Those reports of explorations and tests of subsurface conditions at or contiguous to the Site that ENGINEER has used in preparing the Contract Documents; and

2. Those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that ENGINEER has used in preparing the Contract Documents.

B. *Limited Reliance by CONTRACTOR on Technical Data Authorized:* CONTRACTOR may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Except for such reliance on such "technical data," CONTRACTOR may not rely upon or make any Claim against OWNER, ENGINEER, or any of ENGINEER's Consultants with respect to:

1. The completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by CONTRACTOR, and safety precautions and programs incident thereto; or

2. Other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. Any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If CONTRACTOR believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

1. Is of such a nature as to establish that any "technical data" on which CONTRACTOR is entitled to rely as provided in paragraph 4.02 is materially inaccurate; or

2. Is of such a nature as to require a change in the Contract Documents; or

3. Differs materially from that shown or indicated in the Contract Documents; or

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

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

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

C. *Possible Price and Times Adjustments*

1. The Contract Price or the Contract Time, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in CONTRACTOR's cost of, or time required for, performance of the Work; subject, however, to the following:

a. Such condition must meet any one or more of the categories described in paragraph 4.03.A; and

b. With respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of paragraphs 9.08 and 11.03.

2. CONTRACTOR shall not be entitled to any adjustment in the Contract Price or Contract Time if:

a. CONTRACTOR knew of the existence of such conditions at the time CONTRACTOR made a final commitment to OWNER in respect of Contract Price and Contract Time by the submission of a Bid or becoming bound under a negotiated contract; or

b. The existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for CONTRACTOR prior to CONTRACTOR's making such final commitment; or

c. CONTRACTOR failed to give the written notice within the time and as required by paragraph 4.03.A.

3. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Time, or both, a Claim may be made therefore as provided in paragraph 10.05. However, OWNER, ENGINEER, and ENGINEER's Consultants shall not be liable to CONTRACTOR for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by CONTRACTOR on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect

to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities, including OWNER, or by others. Unless it is otherwise expressly provided for elsewhere:

1. OWNER and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data; and

2. The cost of all of the following will be included in the Contract Price, and CONTRACTOR shall have full responsibility for:

a. Reviewing and checking all such information and data,

b. Locating all Underground Facilities shown or indicated in the Contract Documents,

c. Coordination of the Work with the owners of such Underground Facilities, including OWNER, during construction, and

d. The safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to OWNER and ENGINEER. ENGINEER will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility.

2. If ENGINEER concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price of Contract Time, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that CONTRACTOR did not know of and could not reasonably have been expected to be aware of or to have anticipated. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Time, OWNER or CONTRACTOR may make a Claim therefore as provided in paragraph 10.05.

4.05 *Reference Points*

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

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* Reference is made to the Supplementary Conditions for the identification of those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the ENGINEER in the preparation of the Contract Documents.

B. *Limited Reliance by CONTRACTOR on Technical Data Authorized:* CONTRACTOR may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," CONTRACTOR may not rely upon or make any Claim against OWNER, ENGINEER or any of ENGINEER's Consultants with respect to:

1. The completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of

construction to be employed by CONTRACTOR and safety precautions and programs incident thereto; or

2. Other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. Any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

C. CONTRACTOR shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. CONTRACTOR shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by CONTRACTOR, Subcontractors, Suppliers, or anyone else for whom CONTRACTOR is responsible.

D. If CONTRACTOR encounters a Hazardous Environmental Condition or if CONTRACTOR or anyone for whom CONTRACTOR is responsible creates a Hazardous Environmental Condition, CONTRACTOR shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by paragraph 6.16); and (iii) notify OWNER and ENGINEER (and promptly thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such condition or take corrective action, if any.

E. CONTRACTOR shall not be required to resume Work in connection with such condition or in any affected area until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If OWNER and CONTRACTOR cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Time, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by CONTRACTOR, either party may make a Claim therefore as provided in paragraph 10.05.

F. If after receipt of such written notice CONTRACTOR does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then OWNER may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If OWNER and CONTRACTOR cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Time as a result of deleting such portion of the Work, then either party may make a Claim therefore as provided in paragraph 10.05. OWNER may have such deleted portion of the Work performed by OWNER's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, OWNER shall indemnify and hold harmless CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, partners, employees, agents, other consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by CONTRACTOR or by anyone for whom CONTRACTOR is responsible. Nothing in this paragraph 4.06.E shall obligate OWNER to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

H. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees, agents, other consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by CONTRACTOR or by anyone for whom CONTRACTOR is responsible. Nothing in this paragraph 4.06.F shall obligate CONTRACTOR to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of paragraphs 4.02, 4.03, and 4.04 are not intended to apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 - BONDS AND INSURANCE

5.01 Performance, Payment, and Other Bonds

A. CONTRACTOR shall furnish performance and payment Bonds as security for the faithful performance and payment of all CONTRACTOR's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as provided otherwise by Laws or Regulations or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Contract Documents. The Performance Bond shall be in an amount at least equal to the Contract Price and the Payment shall be in an amount of 100% of the Contract Price.

B. All Bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act. Furnish performance and payment bonds on standard surety bond forms.

C. If the surety on any Bond furnished by CONTRACTOR is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of paragraph 5.01.B, CONTRACTOR shall within 20 days thereafter substitute another Bond and surety, both of which shall comply with the requirements of paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

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

5.03 *Certificates of Insurance*

A. CONTRACTOR shall deliver to OWNER, with copies to each additional insured, certificates of insurance (and other evidence of insurance requested by OWNER or any other additional insured) which CONTRACTOR is required to purchase and maintain. OWNER shall deliver to CONTRACTOR, with copies to each additional insured, certificates of insurance (and other evidence of insurance requested by CONTRACTOR or any other additional insured) which OWNER is required to purchase and maintain.

5.04 *CONTRACTOR's Liability Insurance*

A. CONTRACTOR shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from CONTRACTOR's performance of the Work and CONTRACTOR's other obligations under the Contract Documents, whether it is to be performed by CONTRACTOR, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. Claims under workers' compensation, disability benefits, and other similar employee benefit acts;
2. Claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR's employees;

3. Claims for damages because of bodily injury, sickness or disease, or death of any person other than CONTRACTOR's employees;

4. Claims for damages insured by reasonably available personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR, or (ii) by any other person for any other reason;

5. Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. Claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance so required by this paragraph 5.04 to be purchased and maintained shall:

1. With respect to insurance required by paragraphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insureds (subject to any customary exclusion in respect of professional liability) OWNER, ENGINEER, ENGINEER's Consultants, and any other individuals or entities identified otherwise, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. Include at least the specific coverages and be written for not less than the limits of liability provided in this section, or required by Laws or Regulations, whichever is greater;

3. Include completed operations insurance;

4. Include contractual liability insurance covering CONTRACTOR's indemnity obligations under paragraphs 6.07, 6.11, and 6.20;

5. Contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least thirty days prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the CONTRACTOR pursuant to paragraph 5.03 will so provide);

6. Remain in effect at least until final payment and at all times thereafter when CONTRACTOR may be correcting, removing, or replacing defective Work in accordance with paragraph 13.07; and

7. With respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and CONTRACTOR shall furnish OWNER and each other additional insured, to whom a certificate of insurance has been issued, evidence satisfactory to OWNER and any such additional insured of continuation of such insurance at final payment and one year thereafter).

C. The limits of liability for the insurance required by paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation, and related coverages under paragraphs 5.04.A.1 and A.2 of the General Conditions shall be in strict accordance with the requirements of the current and applicable Workmen's Compensation Laws of the State. The insurance shall cover all of the Contractor's employees employed or associated with the project; and where any part of the work is subcontracted, the Contractor shall require the subcontractor to provide similar Workmen's compensation and Employer's liability Insurance for all employees of the subcontractor unless such employees are covered by the protection afforded by the Contractor.

2. Contractor's General Liability under paragraphs 5.04.A.3 through A.6 of the General Conditions, which shall include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of Contractor:

a. General Aggregate - $2,000,000

b. Products - Completed Operations Aggregate -$1,000,000

c. Personal Injury - $1,000,000

d. Each Occurrence (Bodily Injury and property Damage) - $1,000,000

e. Property Damage liability insurance will provide Explosion, Collapse, and Underground coverages where applicable.

f. Excess or Umbrella Liability

1) General Aggregate - $2,000,000

2) Each Occurrence -$2,000,000

3. Automobile Liability under paragraph 5.04.A.6 of the General Conditions:

a. Bodily Injury:
Each person - $500,000
Each Accident - $1,000,000

b. Property Damage:
Each Accident - $250,000

c. Combined Single Limit of
$1,000,000

4. The Contractual Liability coverage required by paragraph 5.04.B.4 of the General Conditions shall provide coverage for not less than the following amounts:

a. Bodily Injury:
Each Accident - $500,000
Annual Aggregate - $1,000,000

b. Property Damage:
Each Accident - $250,000
Annual Aggregate - $1,000,000

5. Special Hazards or Perils - The Liability and Property Damage Insurance Coverage of the Contractor's operations shall provide adequate protection against any death, any bodily injury or any property damage resulting from the blasting operations in connection with the Contractors work, or in connection with the work of his subcontractors.

Insurance carried by the Contractor on the insurable portions of the work shall not relieve the Contractor of the responsibility for the protection of all materials and all work until the project has been accepted by the Owner. Any loss suffered on the project by reason of the peril listed in SC-5.06 or in this sub-part of SC-5.04 shall be borne by the Contractor and/or the Insurance Company providing the coverage for the Contractor; and the Owner shall not be liable for any cost of replacement of lost or damaged work or material

6. Protection of the Owner and the Engineers: The Contractor hereby agrees to hold harmless, indemnify and defend the Owner, the Owner's agent, the Consulting Engineer, and the Owner's employees while acting within the scope of their duties from and against any and all liability, claims, damages, and cost of defense arising out of the Contractor's performance of the work described herein but not including the sole negligence of the Owner, its agents or employees. The Contractor will require any and all subcontractors to conform with the provisions of this clause prior to commencing any work.

The Contractor shall furnish two (2) Owner's Protective Liability Policies; Named Insureds shall be as follows:

1. **Owner's name**
2. **Three Notch Group, Inc.**

This insurance coverage shall be provided in **two (2) different policies separate from the Contractor's insurance policies**, a copy of the policies shall be provided to the Engineer. The limits of liability shall not be less than $1,000,000.00.

5.05 *OWNER's Liability Insurance*

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

5.06 *Property Insurance*

A. Unless otherwise provided in the Supplementary Conditions, OWNER shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. Include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an additional insured;

2. Be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;

3. Include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. Cover materials and equipment stored at the Site or at another location that was agreed to in writing by OWNER prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by ENGINEER;

5. Allow for partial utilization of the Work by OWNER;

6. Include testing and startup; and

7. Be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR, and ENGINEER with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

B. OWNER shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and any other individuals or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with paragraph 5.07.

D. OWNER shall not be responsible for purchasing and maintaining any property insurance specified in this paragraph 5.06 to protect the interests of CONTRACTOR, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by CONTRACTOR, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

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

5.07 *Waiver of Rights*

A. OWNER and CONTRACTOR intend that all policies purchased in accordance with paragraph 5.06 will protect OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and all other individuals or entities to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. OWNER and CONTRACTOR waive all rights against each other and their respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, ENGINEER, ENGINEER's Consultants, and all other individuals or entities to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by OWNER as trustee or otherwise payable under any policy so issued.

B. OWNER waives all rights against CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees, agents, and other 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 peril whether or not insured by OWNER; and

2. Loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by OWNER during partial utilization pursuant to paragraph 14.05, after Substantial Completion pursuant to paragraph 14.04, or after final payment pursuant to paragraph 14.07.

C. Any insurance policy maintained by OWNER covering any loss, damage or consequential loss referred to in paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against CONTRACTOR, Subcontractors, ENGINEER, or ENGINEER's Consultants and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by paragraph 5.06 will be adjusted with OWNER and made payable to OWNER as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.08.B. OWNER shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.

B. OWNER as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to OWNER's exercise of this power. If such objection be made, OWNER as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, OWNER as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, OWNER as fiduciary shall give bond for the proper performance of such duties.

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

A. If either OWNER or CONTRACTOR has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by paragraph 2.05.C. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the Bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent Bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

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

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

A. CONTRACTOR shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of OWNER or ENGINEER in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly

required by the Contract Documents. CONTRACTOR shall be responsible to see that the completed Work complies accurately with the Contract Documents.

B. At all times during the progress of the Work, CONTRACTOR shall assign a competent resident superintendent thereto who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The superintendent will be CONTRACTOR's representative at the Site and shall have authority to act on behalf of CONTRACTOR. All communications given to or received from the superintendent shall be binding on CONTRACTOR.

6.02 *Labor; Working Hour*

A. CONTRACTOR shall provide competent, suitably qualified personnel to survey, lay out, and construct the Work 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, and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday, or any legal holiday without OWNER's written consent (which will not be unreasonably withheld) given after prior written notice to ENGINEER.

6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the General Requirements, CONTRACTOR shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for 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. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 *Progress Schedule*

A. CONTRACTOR shall adhere to the progress schedule established in accordance with paragraph 2.07 as it may be adjusted from time to time as provided below.

1. CONTRACTOR shall submit to ENGINEER for acceptance (to the extent indicated in paragraph 2.07) proposed adjustments in the progress schedule that will not result in changing the Contract Time (or Milestones). Such adjustments will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the progress schedule that will change the Contract Time (or Milestones) shall be submitted in accordance with the requirements of Article 12. Such adjustments may only be made by a Change Order or Written Amendment in accordance with Article 12.

6.05 *Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to ENGINEER for review under the circumstances described below.

1. *"Or-Equal" Items:* If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an "or-equal" item, in which case review and approval of the proposed item may, in ENGINEER's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. In the exercise of reasonable judgment ENGINEER determines that: (i) it is at least equal in quality, durability, appearance, strength, and design characteristics; (ii) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole, and;

b. CONTRACTOR certifies that: (i) there is no increase in cost to the OWNER; and (ii) it will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Documents.

2. Substitute Items

a. If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an "or-equal" item under paragraph 6.05.A.1, it will be considered a proposed substitute item.

b. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefore. Requests for review of proposed substitute items of material or equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR.

c. The procedure for review by ENGINEER will be as set forth in paragraph 6.05.A.2.d, as supplemented in the General Requirements and as ENGINEER may decide is appropriate under the circumstances.

d. CONTRACTOR shall first 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 shall certify that the proposed substitute item will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified. The application will state the extent, if any, to which the use of the proposed substitute item will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not 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 work on the Project) to adapt the design to the proposed substitute item and whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute item from that specified will be identified in the application, and available engineering, sales, maintenance, repair, and replacement services will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change, all of which will be considered by ENGINEER in evaluating the proposed substitute item. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute item.

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is shown or indicated in and expressly required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by ENGINEER. CONTRACTOR shall submit sufficient information to allow ENGINEER, in ENGINEER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in subparagraph 6.05.A.2.

C. *Engineer's Evaluation:* ENGINEER will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.05.A and 6.05.B. ENGINEER will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized until ENGINEER's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." ENGINEER will advise CONTRACTOR in writing of any negative determination.

D. *Special Guarantee:* OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any substitute.

E. *ENGINEER's Cost Reimbursement:* ENGINEER will record time required by ENGINEER and ENGINEER's Consultants in evaluating substitute proposed or submitted by CONTRACTOR pursuant to paragraphs 6.05.A.2 and 6.05.B and in making changes in the Contract Documents (or in the provisions of any other direct contract with

OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER approves a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluating each such proposed substitute.

F. *CONTRACTOR's Expense:* CONTRACTOR shall provide all data in support of any proposed substitute or "or-equal" at CONTRACTOR's expense.

6.06 *Concerning Sub-contractors, Suppliers, and Others*

A. CONTRACTOR shall not employ any Sub-contractor, Supplier, or other individual or entity (including those acceptable to OWNER as indicated in paragraph 6.06.B), whether initially or as a replacement, against whom OWNER may have reasonable objection. CONTRACTOR shall not be required to employ any Sub-contractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Sub-contractors, Suppliers, or other individuals or entities to be submitted to OWNER in advance for acceptance by OWNER by a specified date prior to the Effective Date of the Agreement, and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, OWNER's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Sub-contractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. CONTRACTOR shall submit an acceptable replacement for the rejected Sub-contractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued, or Written Amendment signed. No acceptance by OWNER of any such Sub-contractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of OWNER or ENGINEER to reject defective Work.

C. CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Sub-contractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Sub-contractor, Supplier, or other individual or entity any contractual relationship between OWNER or ENGINEER and any such Sub-contractor, Supplier or other individual or entity, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Sub-contractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. CONTRACTOR shall be solely responsible for scheduling and coordinating the Work of Sub-contractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR.

E. CONTRACTOR shall require all Sub-contractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with ENGINEER through CONTRACTOR.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Sub-contractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for CONTRACTOR by a Sub-contractor or Supplier will be pursuant to an appropriate agreement between CONTRACTOR and the Sub-contractor or Supplier which specifically binds the Sub-contractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER. Whenever any such agreement is with a Sub-contractor or Supplier who is listed as an additional insured on the property insurance provided in paragraph 5.06, the agreement between the CONTRACTOR and the Sub-contractor or Supplier will contain provisions whereby the Sub-contractor or Supplier waives all rights against OWNER, CONTRACTOR, ENGINEER, ENGINEER's Consultants, and all other individuals or entities to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, and other consultants and Sub-contractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Sub-contractor or Supplier, CONTRACTOR will obtain the same.

H. The CONTRACTOR shall not award work to subcontractor(s) in excess of thirty (30%) percent of the contract price, without prior written approval of the Owner.

6.07 *Patent Fees*

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. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees or agents, and other consultants of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 *Permits*

A. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto, such as plant investment fees.

6.09 *Laws and Regulations*

A. CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws or Regulations.

B. If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, CONTRACTOR shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work; however, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve CONTRACTOR of CONTRACTOR's obligations under paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work may be the subject of an adjustment in Contract Price or Contract Time. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefore as provided in paragraph 10.05.

6.10 *Taxes*

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

B. OWNER will obtain an exemption certificate for the CONTRACTOR for taxes and duties on certain Products or items, for purchasing Products or items for the Work.

6.11 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*

1. CONTRACTOR shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultant, and the officers, directors, partners, employees, agents, and other consultants of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against OWNER, ENGINEER, or any other party indemnified hereunder to the extent caused by or based upon CONTRACTOR's performance of the Work.

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

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

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

6.12 *Record Documents*

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

6.13 *Safety and Protection*

A. CONTRACTOR shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. All persons on the Site or who may be affected by the Work;

2. All the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. Other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. CONTRACTOR shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property. All damage, injury, or loss to any property referred to in paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or ENGINEER's Consultant, 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). CONTRACTOR's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

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

6.15 *Hazard Communication Programs*

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

6.16 *Emergencies*

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

6.17 *Shop Drawings and Samples*

A. CONTRACTOR shall submit Shop Drawings to ENGINEER for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals. All submittals will be identified as ENGINEER may require and in the number of copies specified in the General Requirements. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show ENGINEER the services, materials, and equipment CONTRACTOR proposes to provide and to enable ENGINEER to review the information for the limited purposes required by paragraph 6.17.E.

B. CONTRACTOR shall also submit Samples to ENGINEER for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers, and the use for which intended and otherwise as ENGINEER may require to enable ENGINEER to review the submittal for the limited purposes required by paragraph 6.17.E. The numbers of each Sample to be submitted will be as specified in the Specifications.

C. Where a Shop Drawing or Sample is required by the Contract Documents or the schedule of Shop Drawings and Sample submittals acceptable to ENGINEER as required by paragraph 2.07, 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.

D. *Submittal Procedures*

1. Before submitting each Shop Drawing or Sample, CONTRACTOR shall have determined and verified:

a. All field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

b. All materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

c. All information relative to means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incident thereto; and

d. CONTRACTOR shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

2. Each submittal shall bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contract Documents with respect to CONTRACTOR's review and approval of that submittal.

3. At the time of each submittal, CONTRACTOR shall give ENGINEER specific written notice of such variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to ENGINEER for review and approval of each such variation.

E. *ENGINEER's Review*

1. ENGINEER will timely review and approve Shop Drawings and Samples in accordance with the schedule of Shop Drawings and Sample submittals acceptable to ENGINEER. ENGINEER's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. ENGINEER's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. ENGINEER's review and approval of Shop Drawings or Samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of each submittal as required by paragraph 6.17.D.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 approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for complying with the requirements of paragraph 6.17.D.1.

F. *Resubmittal Procedures*

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

6.18 *Continuing the Work*

A. CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.04 or as OWNER and CONTRACTOR may otherwise agree in writing.

6.19 *CONTRACTOR's General Warranty and Guarantee*

A. CONTRACTOR warrants and guarantees to OWNER, ENGINEER, and ENGINEER's Consultants that all Work will be in accordance with the Contract Documents and will not be defective. 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.

B. 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 acceptance by OWNER or any failure to do so;

6. Any review and approval of a Shop Drawing or Sample submittal or 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.

6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants, 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 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:

1. 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; and

2. Is caused in whole or in part 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, regardless of whether or not caused in part by any negligence or omission of an individual or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such individual or entity.

B. In any and all claims against OWNER or ENGINEER or any of their respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of CONTRACTOR, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for CONTRACTOR or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of CONTRACTOR under paragraph 6.20.A shall not extend to the liability of ENGINEER and ENGINEER's Consultants or to the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them 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.

ARTICLE 7 - OTHER WORK

7.01 *Related Work at Site*

A. OWNER may perform other work related to the Project at the Site by OWNER's employees, or let other direct contracts therefore, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. Written notice thereof will be given to CONTRACTOR prior to starting any such other work; and

2. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Time that should be allowed as a result of such other work, a Claim may be made therefore as provided in paragraph 10.05.

B. CONTRACTOR shall afford each other contractor who is a party to such a direct contract and each utility owner (and OWNER, if OWNER is performing the other work with OWNER's employees) proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, 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 their work and will only cut or alter their work with the written consent of ENGINEER and the others whose work will be affected. The duties and responsibilities of CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of CONTRACTOR in said direct contracts between OWNER and such utility owners and other contractors.

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

7.02 *Coordination*

A. If OWNER intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. The individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. The specific matters to be covered by such authority and responsibility will be itemized; and

3. The extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, OWNER shall have sole authority and responsibility for such coordination.

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.02 *Replacement of ENGINEER*

A. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer to whom CONTRACTOR makes no reasonable objection, whose status under the Contract Documents shall be that of the former ENGINEER.

8.03 *Furnish Data*

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

8.04 *Pay Promptly When Due*

A. OWNER shall make payments to CONTRACTOR promptly when they are due as provided in paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. OWNER's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.01 and 4.05. Paragraph 4.02 refers to OWNER's identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by ENGINEER in preparing the Contract Documents.

8.06 *Insurance*

A. OWNER's responsibilities, if any, in respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

A. OWNER is obligated to execute Change Orders as indicated in paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. OWNER's responsibility in respect to certain inspections, tests, and approvals is set forth in paragraph 13.03.B.

8.09 *Limitations on OWNER's Responsibilities*

A. The OWNER shall not supervise, direct, or have control or authority over, nor be responsible for, CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work. OWNER will not be responsible for CONTRACTOR's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

A. OWNER's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. If and to the extent OWNER has agreed to furnish CONTRACTOR reasonable evidence that financial arrangements have been made to satisfy OWNER's obligations under the Contract Documents, OWNER's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *OWNER'S Representative*

A. ENGINEER will be OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER's representative during construction are set forth in the Contract Documents and will not be changed without written consent of OWNER and ENGINEER.

9.02 *Visits to Site*

A. ENGINEER will make visits to the Site at intervals appropriate to the various stages of construction as ENGINEER deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of CONTRACTOR's executed Work. Based on information obtained during such visits and observations, ENGINEER, for the benefit of OWNER, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. ENGINEER's efforts will be directed toward providing for OWNER a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against defective Work.

B. ENGINEER's visits and observations are subject to all the limitations on ENGINEER's authority and responsibility set forth in paragraph 9.10, and particularly, but without limitation, during or as a result of ENGINEER's visits or observations of CONTRACTOR's Work ENGINEER will not supervise, direct, control, or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

A. If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in providing more extensive observation of the Work. The responsibilities and authority and limitations thereon of any such Resident Project Representative and assistants will be as provided in paragraph 9.10. If OWNER designates another representative or agent to represent OWNER at the Site who is not ENGINEER's Consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Clarifications and Interpretations*

A. ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents as ENGINEER may determine necessary, which shall be consistent with the intent of and reasonably inferable from the Contract Documents. Such written clarifications and interpretations will be binding on OWNER and CONTRACTOR. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Time, or both, that should be allowed as a result of a written clarification or interpretation, a Claim may be made therefore as provided in paragraph 10.05.

9.05 *Authorized Variations in Work*

A. ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Time and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on OWNER and also on CONTRACTOR, who shall perform the Work involved promptly. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Time, or both, as a result of a

Field Order, a Claim may be made therefore as provided in paragraph 10.05.

9.06 *Rejecting Defective Work*

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

9.07 *Shop Drawings, Change Orders and Payments*

A. In connection with ENGINEER's authority as to Shop Drawings and Samples, see paragraph 6.17.

B. In connection with ENGINEER's authority as to Change Orders, see Articles 10, 11, and 12.

C. In connection with ENGINEER's authority as to Applications for Payment, see Article 14.

9.08 *Determinations for Unit Price Work*

A. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR the ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decision thereon will be final and binding (except as modified by ENGINEER to reflect changed factual conditions or more accurate data) upon OWNER and CONTRACTOR, subject to the provisions of paragraph 10.05.

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

A. ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes and other matters relating to the acceptability of the Work, the quantities and classifications of Unit Price Work, the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, and Claims seeking changes in the Contract Price or Contract Time will be referred initially to ENGINEER in writing, in accordance with the provisions of paragraph 10.05, with a request for a formal decision.

B. When functioning as interpreter and judge under this paragraph 9.09, ENGINEER will not show partiality to OWNER or CONTRACTOR and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by ENGINEER pursuant to this paragraph 9.09 with respect to any such Claim, dispute, or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.07) will be a condition precedent to any exercise by OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such Claim, dispute, or other matter.

9.10 *Limitations on ENGINEER's Authority and Responsibilities*

A. Neither ENGINEER's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by ENGINEER shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. ENGINEER will not supervise, direct, control, or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work. ENGINEER will not be responsible for CONTRACTOR's failure to perform the Work in accordance with the Contract Documents.

C. ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. ENGINEER's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

E. The limitations upon authority and responsibility set forth in this paragraph 9.10 shall also apply to ENGINEER's Consultants, Resident Project Representative, and assistants.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

A. Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved, which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If OWNER and CONTRACTOR are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Time, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefore as provided in paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

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

10.03 *Execution of Change Orders*

A. OWNER and CONTRACTOR shall execute appropriate Change Orders recommended by ENGINEER (or Written Amendments) covering:

1. Changes in the Work which are: (i) ordered by OWNER pursuant to paragraph 10.01.A, (ii) required because of acceptance of defective Work under paragraph 13.08.A or OWNER's correction of defective Work under paragraph 13.09, or (iii) agreed to by the parties;

2. Changes in the Contract Price or Contract Time which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. Changes in the Contract Price or Contract Time which embody the substance of any written decision rendered by ENGINEER pursuant to paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.18.A.

10.04 *Notification to Surety*

A. If notice 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 Time) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be CONTRACTOR's responsibility. The amount of each applicable Bond will be adjusted to reflect the effect of any such change.

10.05 *Claims and Disputes*

A. *Notice:* Written notice stating the general nature of each Claim, dispute, or other matter shall be delivered by the claimant to ENGINEER and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. Notice of the amount or extent of the Claim, dispute, or other matter with supporting data shall be delivered to the ENGINEER and the other party to the Contract within 60 days after the start of such event (unless ENGINEER allows additional time for claimant to submit additional or more accurate data in support of such Claim, dispute, or other matter). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to ENGINEER and the claimant within 30 days after receipt of the claimant's last submittal (unless ENGINEER allows additional time).

B. *ENGINEER's Decision:* ENGINEER will render a formal decision in writing within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any. ENGINEER's written decision on

such Claim, dispute, or other matter will be final and binding upon OWNER and CONTRACTOR unless:

1. An appeal from ENGINEER's decision is taken within the time limits and in accordance with the dispute resolution procedures set forth in Article 16; or

2. If no such dispute resolution procedures have been set forth in Article 16, a written notice of intention to appeal from ENGINEER's written decision is delivered by OWNER or CONTRACTOR to the other and to ENGINEER within 30 days after the date of such decision, and a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction within 60 days after the date of such decision or within 60 days after Substantial Completion, whichever is later (unless otherwise agreed in writing by OWNER and CONTRACTOR), to exercise such rights or remedies as the appealing party may have with respect to such Claim, dispute, or other matter in accordance with applicable Laws and Regulations.

C. If ENGINEER does not render a formal decision in writing within the time stated in paragraph 10.05.B, a decision denying the Claim in its entirety shall be deemed to have been issued 31 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any.

D. No Claim for an adjustment in Contract Price or Contract Time (or Milestones) will be valid if not submitted in accordance with this paragraph 10.05.

ARTICLE 11 - COST OF THE WORK; CASH ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to CONTRACTOR will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in paragraph 11.01.B.

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 at the Site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by OWNER.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

3. Payments made by CONTRACTOR to Subcontractors for Work performed by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from subcontractors acceptable to OWNER and CONTRACTOR and shall deliver such bids to OWNER, who will then determine, with the advice of ENGINEER, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as CONTRACTOR's Cost of the Work and fee as provided in this paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants)

employed for services specifically related to the Work.

5. Supplemental costs including the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of CONTRACTOR's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of CONTRACTOR.

c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by CONTRACTOR in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expressage, and similar petty cash items in connection with the Work.

i. When the Cost of the Work is used to determine the value of a Change Order or of a Claim, the cost of premiums for additional Bonds and insurance required because of the changes in the Work or caused by the event giving rise to the Claim.

j. When all the Work is performed on the basis of cost-plus, the costs of premiums for all Bonds and insurance CONTRACTOR is required by the Contract Documents to purchase and maintain.

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

1. Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnerships and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by CONTRACTOR, whether at the Site or in CONTRACTOR's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.01.A.1 or specifically covered by paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the CONTRACTOR's fee.

2. Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the Site.

3. Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR's

capital employed for the Work and charges against CONTRACTOR for delinquent payments.

4. Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraphs 11.01.A and 11.01.B.

C. *CONTRACTOR's Fee:* When all the Work is performed on the basis of cost-plus, CONTRACTOR's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, CONTRACTOR's fee shall be determined as set forth in paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to paragraphs 11.01.A and 11.01.B, CONTRACTOR will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

11.02 *Cash 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 as may be acceptable to OWNER and ENGINEER. CONTRACTOR agrees that:

1. The 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 costs, overhead, profit, and other expenses contemplated for the 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.

B. Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER subject to the provisions of paragraph 9.08.

B. 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.

C. OWNER or CONTRACTOR may make a Claim for an adjustment in the Contract Price in accordance with paragraph 10.05 if:

1. The quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

2. There is no corresponding adjustment with respect any other item of Work; and

3. if CONTRACTOR believes that CONTRACTOR is entitled to an increase in Contract Price as a result of having incurred additional expense or OWNER believes that OWNER is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIME

12.01 *Change of Contract Price*

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

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. Where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of paragraph 11.03); or

2. Where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 12.01.C.2); or

3. Where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in paragraph 11.01) plus a CONTRACTOR's fee for overhead and profit (determined as provided in paragraph 12.01.C).

C. *CONTRACTOR's Fee:* The CONTRACTOR's fee for overhead and profit shall be determined as follows:

1. The Agreement identifies the following:

a. Overhead and profit fees applicable to Changes in the Work, whether additions to or deductions from the Work on which the Contract Price is based.

b. Fees for changes in subcontract work (both additions and deductions)

c. The Contractor shall apply fees as noted, to the Subcontractor's gross (net plus fee) costs on additional work.

2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. For costs incurred under paragraphs 11.01.A.1 and 11.01.A.2, the CONTRACTOR's fee shall be 15 percent;

b. For costs incurred under paragraph 11.01.A.3, the CONTRACTOR's fee shall be five percent;

c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of paragraph 12.01.C.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and CONTRACTOR will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. No fee shall be payable on the basis of costs itemized under paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

e. The amount of credit to be allowed by CONTRACTOR to OWNER for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in CONTRACTOR's fee by an amount equal to five percent of such net decrease; and

f. When both additions and credits are involved in any one change, the adjustment in CONTRACTOR's fee shall be computed on the basis of the net change in accordance with paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Time*

A. The Contract Time (or Milestones) may only be changed by a Change Order or by a Written Amendment. Any Claim for an adjustment in the Contract Time (or Milestones) shall be based on written notice submitted by the party making the claim to the ENGINEER and the other party to the Contract in accordance with the provisions of paragraph 10.05.

B. Any adjustment of the Contract Time (or Milestones) covered by a Change Order or of any Claim for

an adjustment in the Contract Time (or Milestones) will be determined in accordance with the provisions of this Article 12.

12.03 *Delays Beyond CONTRACTOR's Control*

A. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Time (or Milestones) due to delay beyond the control of CONTRACTOR, the Contract Time (or Milestones) will be extended in an amount equal to the time lost due to such delay if a Claim is made therefore as provided in paragraph 12.02.A. Delays beyond the control of CONTRACTOR shall include, but not be limited to, acts or neglect by OWNER, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

12.04 *Delays Within CONTRACTOR's Control*

A. The Contract Time (or Milestones) will not be extended due to delays within the control of CONTRACTOR. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of CONTRACTOR.

12.05 *Delays Beyond OWNER's and CONTRACTOR's Control*

A. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Time (or Milestones) due to delay beyond the control of both OWNER and CONTRACTOR, an extension of the Contract Time (or Milestones) in an amount equal to the time lost due to such delay shall be CONTRACTOR's sole and exclusive remedy for such delay.

12.06 *Delay Damages*

A. In no event shall OWNER or ENGINEER be liable to CONTRACTOR, any Subcontractor, any Supplier, or any other person or organization, or to any surety for or employee or agent of any of them, for damages arising out of or resulting from:

1. Delays caused by or within the control of CONTRACTOR; or

2. Delays beyond the control of both OWNER and CONTRACTOR including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God, or acts or neglect by utility owners or other contractors performing other work as contemplated by Article 7.

B. Nothing in this paragraph 12.06 bars a change in Contract Price pursuant to this Article 12 to compensate CONTRACTOR due to delay, interference, or disruption directly attributable to actions or inactions of OWNER or anyone for whom OWNER is responsible.

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

13.01 *Notice of Defects*

A. Prompt notice of all defective Work of which OWNER or ENGINEER has actual knowledge will be given to CONTRACTOR. All defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 *Access to Work*

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

13.03 *Tests and Inspections*

A. CONTRACTOR shall give ENGINEER timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. OWNER shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. For inspections, tests, or approvals covered by paragraphs 13.03.C and 13.03.D below;

2. That costs incurred in connection with tests or inspections conducted pursuant to paragraph 13.04.B shall be paid as provided in said paragraph 13.04.B; and

3. As otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, CONTRACTOR shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish ENGINEER the required certificates of inspection or approval.

D. CONTRACTOR shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for OWNER's and ENGINEER's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to OWNER and ENGINEER.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by CONTRACTOR without written concurrence of ENGINEER, it must, if requested by ENGINEER, be uncovered for observation.

F. Uncovering Work as provided in paragraph 13.03.E shall be at CONTRACTOR's expense unless CONTRACTOR has given ENGINEER timely notice of CONTRACTOR's intention to cover the same and ENGINEER has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER's observation and replaced at CONTRACTOR's expense.

B. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment. If it is found that such Work is defective, CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and OWNER shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, OWNER may make a Claim therefore as provided in paragraph 10.05. If, however, such Work is not found to be defective, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a Claim therefore as provided in paragraph 10.05.

13.05 *OWNER May Stop the Work*

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

13.06 *Correction or Removal of Defective Work*

A. CONTRACTOR shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by ENGINEER, remove it from the Project and replace it with Work that is not defective. CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

13.07 *Correction Period*

A. If within one year after the date of final payment to the CONTRACTOR or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for CONTRACTOR's use by OWNER or permitted by Laws and Regulations as contemplated in paragraph 6.11.A is found to be defective, CONTRACTOR shall promptly,

without cost to OWNER and in accordance with OWNER's written instructions: (i) repair such defective land or areas, or (ii) correct such defective Work or, if the defective Work has been rejected by OWNER, remove it from the Project and replace it with Work that is not defective, and (iii) satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the defective Work corrected or repaired or may have the rejected Work removed and replaced, and all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by CONTRACTOR.

B. 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 or by Written Amendment.

C. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

D. CONTRACTOR's obligations under this paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

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

13.09 *OWNER May Correct Defective Work*

A. If CONTRACTOR fails within a reasonable time after written notice from ENGINEER to correct defective Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.06.A, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, OWNER may, after seven days written notice to CONTRACTOR, correct and remedy any such deficiency.

B. In exercising the rights and remedies under this paragraph, OWNER shall proceed expeditiously. In connection with such corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the Site, take possession of all or part of the Work and suspend CONTRACTOR's services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees, OWNER's other contractors, and ENGINEER and ENGINEER's Consultants access to the Site to enable OWNER to exercise the rights and remedies under this paragraph.

C. All Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by OWNER in exercising the rights and remedies under this paragraph 13.09 will be charged against CONTRACTOR, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, OWNER may make a Claim therefore as provided in paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair,

or replacement of work of others destroyed or damaged by correction, removal, or replacement of CONTRACTOR's defective Work.

D. CONTRACTOR shall not be allowed an extension of the Contract Time (or Milestones) because of any delay in the performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies under this paragraph 13.09.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

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

14.02 *Progress Payments*

A. *Applications for Payments*

1. At least 20 days before the date established for each progress payment (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that OWNER has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect OWNER's interest therein, all of which must be satisfactory to OWNER.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of CONTRACTOR stating that all previous progress payments received on account of the Work have been applied on account to discharge CONTRACTOR's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. *Review of Applications*

1. ENGINEER will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to OWNER or return the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application.

2. ENGINEER's recommendation of any payment requested in an Application for Payment will constitute a representation by ENGINEER to OWNER, based on ENGINEER's observations on the Site 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, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under paragraph 9.08, and to 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: (i) inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed

inspections of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents; or (ii) that 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 to supervise, direct, or control the Work or for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for CONTRACTOR's failure to comply with Laws and Regulations applicable to CONTRACTOR's performance of the Work. Additionally, said review or recommendation will not impose responsibility on ENGINEER to make any examination to ascertain how or for what purposes CONTRACTOR has used the moneys paid on account of the Contract Price, or 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 referred to in paragraph 14.02.B.2. ENGINEER may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

a. The Work is defective, or completed Work has been damaged, requiring correction or replacement;

b. The Contract Price has been reduced by Written Amendment or Change Orders;

c. OWNER has been required to correct defective Work or complete Work in accordance with paragraph 13.09; or

d. ENGINEER has actual knowledge of the occurrence of any of the events enumerated in paragraph 15.02.A.

C. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to OWNER with ENGINEER's recommendation, the amount recommended will (subject to the provisions of paragraph 14.02.D) become due, and when due will be paid by OWNER to CONTRACTOR.

D. *Reduction in Payment*

1. OWNER may refuse to make payment of the full amount recommended by ENGINEER because:

a. Claims have been made against OWNER on account of CONTRACTOR's performance or furnishing of the Work;

b. Liens have been filed in connection with the Work, except where CONTRACTOR has delivered a specific Bond satisfactory to OWNER to secure the satisfaction and discharge of such Liens;

c. There are other items entitling OWNER to a set-off against the amount recommended; or

d. OWNER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.02.B.5.a through 14.02.B.5.c or paragraph 15.02.A.

2. If OWNER refuses to make payment of the full amount recommended by ENGINEER, OWNER must give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action and promptly pay CONTRACTOR any amount remaining after deduction of the amount so withheld. OWNER shall promptly pay CONTRACTOR the amount so withheld, or any adjustment thereto agreed to by OWNER and CONTRACTOR, when CONTRACTOR corrects to OWNER's satisfaction the reasons for such action.

3. If it is subsequently determined that OWNER's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by paragraph 14.02.C.1.

14.03 *CONTRACTOR's Warranty of Title*

A. CONTRACTOR warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the

Project or not, will pass to OWNER no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

A. Substantial completion of project shall be defined as the time at which all pay items have been completed and OWNER can fully utilize the new facilities.

B. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Promptly thereafter, 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 thereof. If ENGINEER considers the Work substantially complete, ENGINEER will prepare and deliver to OWNER a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. OWNER shall have seven days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached list. If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER will within 14 days after submission of the tentative certificate to OWNER notify CONTRACTOR in writing, stating the reasons therefore. If, after consideration of OWNER's objections, ENGINEER considers the Work substantially complete, ENGINEER will within said 14 days execute and deliver to OWNER and CONTRACTOR a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as ENGINEER believes justified after consideration of any objections from OWNER. At the time of delivery of the tentative certificate of Substantial Completion ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform ENGINEER in writing prior to ENGINEER's issuing the definitive certificate of Substantial Completion, ENGINEER's aforesaid recommendation will be binding on OWNER and CONTRACTOR until final payment.

C. After substantial completion there shall be a 30-day maintenance period in which items shall be completed by the CONTRACTOR prior to final payment.

D. OWNER shall have the right to exclude CONTRACTOR from the Site after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

14.05 *Partial Utilization*

A. Use by OWNER at OWNER's option of 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, may be accomplished prior to Substantial Completion of all the Work subject to the following conditions.

1. OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees that such part of the Work is substantially complete, CONTRACTOR will certify to OWNER and ENGINEER that such part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. CONTRACTOR at any time may notify OWNER and ENGINEER in writing that CONTRACTOR considers any such part of the Work ready for its intended use and substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. 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 therefore. If ENGINEER considers that part of the Work to be substantially complete, the provisions of paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

2. No occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

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

14.07 *Final Payment*

A. *Application for Payment*

1. After CONTRACTOR has, in the opinion of ENGINEER, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, Bonds, certificates or other evidence of insurance certificates of inspection, marked-up record documents (as provided in paragraph 6.12), and other documents, CONTRACTOR may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by: (i) all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by subparagraph 5.04; (ii) consent of the surety, if any, to final payment; and (iii) complete and legally effective releases or waivers (satisfactory to OWNER) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in paragraph 14.07.A.2 and as approved by OWNER, CONTRACTOR may furnish receipts or releases in full and an affidavit of CONTRACTOR that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which OWNER or OWNER's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Lien.

B. *Advertisement of Closing*

1. The Contractor shall attach to the final payment estimate an affidavit of publication (with clipping) from a newspaper of general circulation in the county where work was done, that completion has been advertised weekly for four consecutive weeks. First notice must be subsequent to completion. Employ the following copy:

"Notice is hereby given that (contractor and address) has completed all work on the (insert name of Project from contract documents). All persons having any claim for labor, materials, or otherwise in connection with this project should immediately notify the above named contractor and the Engineer.

C. *Review of Application and Acceptance*

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

D. *Payment Becomes Due*

1. Thirty days after the presentation to OWNER of the Application for Payment and accompanying documentation, the amount recommended by ENGINEER will become due and, when due, will be paid by OWNER to CONTRACTOR.

2. The 1-year warranty period (work and materials) shall commence on the date of final payment to the CONTRACTOR.

14.08 *Final Completion Delayed*

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

14.09 *Waiver of Claims*

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

1. A waiver of all Claims by OWNER against CONTRACTOR, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from CONTRACTOR's continuing obligations under the Contract Documents; and

2. A waiver of all Claims by CONTRACTOR against OWNER other than those previously made in writing which are still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 *OWNER May Suspend Work*

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

15.02 *OWNER May Terminate for Cause*

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

1. CONTRACTOR's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.07 as adjusted from time to time pursuant to paragraph 6.04);

2. CONTRACTOR's disregard of Laws or Regulations of any public body having jurisdiction;

3. CONTRACTOR's disregard of the authority of ENGINEER; or

4. CONTRACTOR's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in paragraph 15.02.A occur, OWNER may, after giving CONTRACTOR (and the surety, if any) seven days written notice, terminate the services of CONTRACTOR, exclude CONTRACTOR from the Site, and take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), 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 finish the Work as OWNER may deem expedient. In such case, CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by OWNER arising out of or relating to completing the Work, such excess will be paid to CONTRACTOR. If such claims, costs, losses, and damages exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such claims, costs, losses, and damages incurred by OWNER will be reviewed by ENGINEER as to their reasonableness and, when so

approved by ENGINEER, incorporated in a Change Order. When exercising any rights or remedies under this paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

C. Where CONTRACTOR's services have been so terminated by OWNER, the termination will not affect any rights or remedies of OWNER against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

15.03 *OWNER May Terminate for Convenience*

A. Upon seven days written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy of OWNER, elect to terminate the Contract. In such case, CONTRACTOR shall be paid (without duplication of any items):

1. For 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. For expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. For all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. For reasonable expenses directly attributable to termination.

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

15.04 *CONTRACTOR May Stop Work or Terminate*

A. If, through no act or fault of CONTRACTOR, the Work is suspended for more than 90 consecutive days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within 30 days after it is submitted, or OWNER fails for 30 days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven days written notice to OWNER and ENGINEER, and provided OWNER or ENGINEER do not remedy such suspension or failure within that time, terminate the Contract and recover from OWNER payment on the same terms as provided in paragraph 15.03. In lieu of terminating the Contract and without prejudice to any other right or remedy, if ENGINEER has failed to act on an Application for Payment within 30 days after it is submitted, or OWNER has failed for 30 days to pay CONTRACTOR any sum finally determined to be due, CONTRACTOR may, seven days after written notice to OWNER and ENGINEER, stop the Work until payment is made of all such amounts due CONTRACTOR, including interest thereon. The provisions of this paragraph 15.04 are not intended to preclude CONTRACTOR from making a Claim under paragraph 10.05 for an adjustment in Contract Price or Contract Time or otherwise for expenses or damage directly attributable to CONTRACTOR's stopping the Work as permitted by this paragraph.

ARTICLE 16 - DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Dispute resolution methods and procedures, if any, shall be as set forth in the Supplementary Conditions. If no method and procedure has been set forth, and subject to the provisions of paragraphs 9.09 and 10.05, OWNER and CONTRACTOR may exercise such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

ARTICLE 17 - MISCELLANEOUS

17.01 *Giving Notice*

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

17.02 *Computation of Times*

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last

day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 *Cumulative Remedies*

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

17.04 *Survival of Obligations*

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

17.05 *Controlling Law*

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

END OF DOCUMENT

DOCUMENT 00800

SUPPLEMENTARY CONDITIONS

1. *General*

1.1 These Supplementary Conditions amend or supplement the General Conditions of the Construction Contract and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions will have the meanings indicated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings indicated below, which are applicable to both the singular and plural thereof.

2. *Article 5 – Bonds and Insurance*

Replace Paragraph 5.06, A. with the following:

A. Builder's Risk: Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be required by Laws and Regulations). This insurance shall:
   1. Include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an additional insured;
   2. Be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils or causes of loss as may be specifically required by the General Conditions 00700 - 17 (Rev. 02-15-22);
   3. Include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
   4. Cover materials and equipment stored at the Site or at another location that was agreed to in writing by OWNER prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by ENGINEER;
   5. Allow for partial utilization of the Work by OWNER;
   6. Include testing and startup; and
   7. Be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR, and ENGINEER with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

END OF DOCUMENT

State of Alabama
Alabama Department of Environmental Management
State Revolving Fund (SRF) Loan Program

SRF Section
Permits and Services Division
Alabama Department of Environmental Management
Post Office Box 301463
Montgomery, Alabama 36130-1463

(334) 271-7793
(334) 271-7950 FAX

Supplemental General Conditions

for SRF Assisted

Public Drinking Water and Wastewater
Facilities Construction Contracts

Clean Water
State Revolving Fund

Protect Our Health from Source to Tap
Drinking Water State Revolving Fund

SRF Project Number: CS010835-03 __

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I – ADEM Special Conditions

1. Construction within State rights-of-way shall be in accordance with the Alabama Department of Transportation policies and procedures.

2. Construction is to be carried out in compliance with applicable NPDES permits and in a manner that prevents bypassing of raw wastewater flows during construction. If bypassing is anticipated, the ADEM NPDES Enforcement Branch (334-271-7975) shall be advised in advance and the contractor shall take all necessary steps to minimize the impacts of bypassing.

3. Siltation and soil erosion shall be minimized during construction. The contractor shall obtain an NPDES storm water permit for construction if required.

4. The owner shall provide and maintain competent and adequate supervision and inspection.

5. ADEM and EPA shall have access to the site and the project work at all times.

6. These Special Conditions shall supersede any conflicting provisions of this contract.

7. **A project sign is required.** See **Parts XVII and XVIII, pages SGC-36 – SGC-37**, for more information.

II – Bonds and Insurance

Bonding requirements shall comply with Alabama Act No. 97-225. Provisions of the Act are summarized below:

1. Bid Bond – Not less than 5% of either the owner's estimated cost or of the proposed prime contractor's bid up to a maximum of $10,000. The bid guarantee shall consist of a cashier's check drawn on an Alabama bank or a bid bond executed by a surety company duly authorized and qualified to make bonds in the State of Alabama.

2. Performance Bond – In an amount not less than 100% of the contract price.

3. Payment Bond – Payable to the awarding authority, shall be executed in an amount not less than 50% of the contract price.

In addition to the insurance requirements elsewhere in the specifications, the owner or the contractor, as appropriate, must acquire any flood insurance made available by the Federal Emergency Management Agency as required by 40 CFR 30.600 (b), if construction will take place in a flood hazard area identified by the Federal Emergency Management Agency.

III – Utilization of Disadvantaged Businesses Enterprises (DBEs)

It is the policy of the State Revolving Loan Fund (SRF) to promote a "fair share" of sub-agreement awards to **small, minority, and/or women-owned businesses** for equipment, supplies, construction, and services. Compliance with these contract provisions is required in order for project costs to be eligible for SRF funding. *The "fair share" objective is a goal, not a quota.* DBE (Disadvantaged Business Enterprise) is an all-inclusive business classification, which includes MBE (minority business enterprises and/or WBE (women business enterprises) and is used synonymously when these entities are referenced individually or collectively.

Failure on the part of the apparent successful bidder to submit required information to the Loan Recipient (Owner) may be considered (by the Loan Recipient (Owner)) in evaluating whether the bidder is responsive to the bid requirements. The project objectives for utilization of Minority Business Enterprises (MBEs) and Women's Business Enterprises (WBEs) are as follows:

Commodities (Supplies)	MBE 4%	WBE 11%
Contractual (Services)	MBE 8%	WBE 30%
Equipment	MBE 5%	WBE 20%
Construction	MBE 2.5%	WBE 3%

For purposes of clarification:

- This objective applies to any Federally assisted procurement agreement in excess of $10,000.
- This objective necessitates three responsibilities; separate solicitations must be made of small and minority and women's business enterprises.
- A minority business is a business, at least 51 percent of which is owned and controlled by minority group members (Black; Hispanic; Asian American; American Indian; and, any other designations approved by the Office of Management and Budget).
- A women's business is a business, at least 51 percent of which is owned and controlled by one or more women.
- The control determination will revolve around the minority or woman owner's involvement in the day-to-day management of the business enterprise.
- Solicitation should allow adequate time for price analysis. ADEM recommends that contact be made no later than 15 days before bid opening.
- Efforts taken to comply with this objective must be documented in detail; maintain records of firms contacted, including any negotiation efforts to reach competitive price levels, and awards to the designated firms.
- ADEM recommends that the Loan Recipient (Owner) or proposed Prime Contractor utilizes the services of the Minority Business Development Service Centers. These Centers are funded by the U.S. Department of Commerce to provide technical, financial and contracting assistance to minority and women's business enterprises. These Centers are located in a number of Regional cities.
- Use of the services provided by these Centers does not absolve the Loan Recipient (Owner) or proposed Prime Contractor from pursuing additional efforts to meet this objective.

IV – Six Affirmative Steps for Good Faith DBE (MBE-WBE) Solicitation

The Loan Recipient (Owner) shall follow the six affirmative steps found in the SRF application when using loan funds to procure sources of supplies, construction and services.

If the successful bidder plans to subcontract a portion of the project, the bidder must submit to the owner within 10 days after bid opening, evidence of the affirmative steps taken to utilize small, minority and women's businesses. These six affirmative steps or 'good faith efforts' are required methods to ensure that DBEs have the opportunity to compete for procurements funded by EPA financial assistance dollars. Such affirmative steps are described as follows:

1. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. This will include placing DBEs on solicitation lists and soliciting them whenever there are potential sources.

2. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.

3. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs. This will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.

4. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.

5. Use the resources, services, and assistance of the AL Department of Transportation (ALDOT), Small Business Administration (SBA), and the Minority Business Development Agency of the Department of Commerce (MBDA).

6. If the Contractor awards subcontracts, it must take the steps described in items (1) through (5) listed above.

V – Documentation Required from Loan Recipient (Owner) and Contractor

The low, responsive, responsible bidder must forward the following items in duplicate, to the loan recipient (owner) no later than 10 days after bid opening. The Loan Recipient (Owner) shall transmit one (1) copy of its DBE documentation of the prime contractor solicitation and one (1) copy of the prime contractor's/bidder's DBE documentation of all subcontractor solicitation to the SRF Section within 14 days after bid opening.

1. SRF project number and project name/loan name*. (*not contract name)

2. List of **all** subcontractors (DBE **and** non-DBE) with name, address, telephone number, estimated contract dollar amount and duration. If there are to be no subcontractors, please indicate such in a letter on company letterhead.

3. List of any subcontract work yet to be committed with estimate of dollar amount and duration of contract.

4. MBE-WBE (DBE) Documents - See **Part V, page SGC-6**.

5. Debarred Firms Certification – See **Part XIV, page SGC-25**.

6. Certification Regarding Equal Employment Opportunity – See **Part XIII, page SGC-24.**

The Loan Recipient (Owner) shall submit annual MBE/WBE Utilization Reports (EPA Form 5700-52A, **pages SGC-16 - SGC-17**) within 30 days of the end of the annual reporting period **(October 30th, i.e. by November 30th)**. Submit reports directly to:

Laketa Ross, Accountant
Administrative Section
Fiscal Branch
Alabama Department of Environmental Management
Post Office Box 301463
Montgomery, Alabama 36130-1463

The proposed Prime Contractor must submit the following items to the Loan Recipient (Owner):

1) DBE Compliance Form. The Loan Recipient (Owner) must submit this information to the SRF Section to demonstratecompliance with the DBE requirements. ADEM's approval is required prior to award of the construction contract and commencement of any SRF-funded construction. **(Page SGC-8)**

2) Certification Regarding Equal Employment Opportunity. This form is required of the proposed prime contractor(re: all subcontracts executed) and should be submitted with the prime proposed contractor's MBE-WBE solicitation submittal to the Loan Recipient (Owner). (**Page SGC-24**)

3) Debarred Firms Certification. This form is required of the proposed prime contractor (re: all subcontracts executed) and should be submitted with the prime proposed contractor's MBE-WBE solicitation submittal to the Loan Recipient (Owner). (**Page SGC-25**)

4) EPA Form 6100-2 DBE Subcontractor Participation Form. This form gives a DBE subcontractor the opportunity to describe the work the DBE subcontractor received from the proposed prime contractor, how much the DBE subcontractor was paid, and any other concerns the DBE subcontractor might have. The proposed prime contractor must provide this form to each DBE subcontractor for the DBE subcontractor's submittal to the SRF Section's MBE-WBE Compliance Staff (to be forwarded to EPA's DBE Coordinator). **(Page SGC-10)**

5) EPA Form 6100-3 DBE Subcontractor Performance Form. This form captures an intended DBE subcontractor's description of work to be performed for the proposed prime contractor and the price of the work. The proposed prime contractor must provide this form to each DBE subcontractor for the DBE subcontractor's submittal to the SRF Section's MBE-WBE Compliance Staff (to be forwarded to EPA's DBE Coordinator). **(Page SGC-12)**

6) EPA Form 6100-4 DBE Subcontractor Utilization Form. This form captures the proposed prime contractor's intended use of all identified DBE subcontractors and the estimated dollar amount of the work. The proposed prime contractor must provide this form to each DBE subcontractor for the DBE subcontractor's submittal to the SRF Section's MBE-WBE Compliance Staff (to be forwarded to EPA's DBE Coordinator). **(Page SGC-14)**

7) EPA Form 5700-52 A MBE/WBE Utilization Reports (DBE Annual Report), if applicable. The Loan Recipient (Owner) must submit this information to the SRF Section within 30 days of the end of the annual reporting period (October 30th), i.e., **by November 30th). (Pages SGC-16 - SGC-17)**

8) Changes to Approved DBE Compliance Form, if applicable. If any changes, substitutions, or additions are proposed to the subcontractors included in previous Department approvals, the Owner must submit this information to the Department for prior approval in order for the affected subcontract work to be eligible for SRF funding. **(Page SGC-23)**

9) Certified Payrolls. These should be submitted to the Loan Recipient (Owner), at least, monthly for the prime contractor and all subcontractors. The Loan Recipient (Owner) must maintain payroll records and make these available for inspection

Please note that DBEs, MBEs, and WBEs must be certified **in writing** by EPA, SBA, or DOT (or by state, local, Tribal, or private entities whose certification criteria match EPA's). Depending upon the certifying agency, a DBE may be classified as a Disadvantaged Business Enterprise (DBE), a Minority Business Enterprise (MBE), or a Women's Business Enterprise (WBE). Written certification as a DBE (MBE or WBE) is required in order to be counted toward the Loan Recipient/Owner's MBE-WBE accomplishments.

The documentation of these good faith solicitation efforts must be detailed in order to allow for satisfactory review. Such documentation might include fax confirmation sheets, copies of solicitation letters/emails, printouts of the online solicitations, printouts of online search results, affidavits of publication in newspapers, etc. The proposed prime contractor is strongly encouraged to follow up each written, fax, or email solicitation with, at least, 1 logged phone call.

The proposed prime contractor must employ the six affirmative steps to subcontract with DBEs, even if the proposed prime contractor has achieved its fair share objectives.

The prime contractor must employ the six affirmative steps to subcontract with DBEs, even if the proposed prime contractor has achieved its fair share objectives. If a DBE subcontractor fails to complete work under the subcontract for any reason, the proposed prime contractor must notify the Loan Recipient (Owner) in writing prior to any termination and must employ the six 'good faith efforts' described above if using a replacement subcontractor. Any proposed changes from an approved DBE subcontractor must be reported to the Loan Recipient (Owner) and to the SRF Section on the Changes to Approved Subcontractors Form prior to initiation of the action. EPA Forms Nos. 6100-3 and 6100-4 must also be submitted to the SRF Section for new DBE subcontracts.

VI – Resources for Identifying MBE-WBE (DBE) Contractors/Subcontractors

The following organizations may provide assistance in soliciting DBE participation:

City of Birmingham
Office of Economic Development
ATTN: **Monique Shorts**,
Economic Specialist
710 20th Street North
Birmingham, Alabama
35203
Ph: (205) 254-2799
Fax: (205) 254-7741
Monique.shorts@birmingham.gov

U.S. Small Business Administration
http://www.pro-net.sba.gov

National Association of Minority Contractors (NAMC)
https://namcatlanta.org/

Alabama Department of Transportation
ATTN: **John Huffman**
1409 Coliseum Boulevard
Montgomery, Alabama
36130
Ph: (334) 244-6261
http://www.dot.state.al.us

U.S. Department of Commerce
Minority Business Development Agency
ATTN: **Donna Ennis**
75 5th Street NW,
Suite 300
Atlanta, Georgia 30308
Ph: (404) 894-2096
http://www.mbda.gov/

Governor's Office of Minority and Women's Business Enterprises
Hilda Lockhart,
STEP Project Director
401 Adams Avenue
Suite 360
Montgomery, Alabama
36130
Ph: (334) 242-2220

Birmingham Construction Industrial Authority ATTN: **Ashley Orl** or **Kimberly Bivins**
601 37th Street South
Birmingham, Alabama
35222
Ph: (205) 324-6202
aorl@bcia1.org
kbaylorbivins@bcia1.org

NOTE:

(1) The Loan Recipient (Owner) and the proposed Prime Contractor shall use the necessary resources to identify and directly solicit no less than three (3) certified DBE/MBE/WBE companies to bid in each expected contract/subcontract area. If a diligent and documented search of ALDOT, SBA, and MBDA directories does not identify three (3) potential certified DBE/MBE/WBE firms, then the proposed Prime Contractor shall post an advertisement in, at least, one (1) of the other online or print resources. Whenever possible, post solicitation for bids or proposals should be posted/advertised for a minimum of 30 calendar days before the bid or proposal closing date.

(2) Expenditures to a DBE that acts merely as a broker or passive conduit of funds, without performing, managing, or supervising the work of its subcontract in a manner consistent with normal business practices may not be counted.

(3) The proposed Prime Contractor should attempt to identify and first solicit DBEs in the geographic proximity of the project before soliciting those located farther away.

(4) In addition, our SRF DBE Compliance Staff is readily available for assistance, as follows: Laketa Ross at (334) 271-7727 or laketa.ross@adem.alabama.gov OR Diane Lockwood (DBE Coordinator) at (334) 271-7815 or dpl@adem.alabama.gov.

VII – DBE Compliance Form

NOTE: FOR DBE COMPLIANCE, ONE (1) COPY OF THIS FORM (WITH ALL INFORMATION OUTLINED) IS REQUIRED (WITH THE LOAN RECIPIENT (OWNER)'S DBE SUBMITTAL) FOR EACH PR&CS REVIEW. THE LOAN RECIPIENT (OWNER) AND PROPOSED PRIME CONTRACTOR SHOULD ENSURE THAT THIS INFORMATION IS COMPLETE *PRIOR TO THE PR&CS SUBMITTAL TO THE SRF SECTION*.

Loan Recipient: City of Troy _ SRF Loan (Project) Number: CS010835-03

CERTIFICATIONS:

I certify that the information submitted on and with this form is true and accurate and that this company has met and will continue to meet the conditions of this construction contract regarding DBE solicitation and utilization. I further certify that criteria used in selecting subcontractors and suppliers were applied equally to all potential participants and that EPA Forms 6100-2 and 6100-3 were distributed to all DBE subcontractors.

_____ Date_____
(Proposed Prime Contractor Signature)

_____
(Printed Name and Title)

I certify that I have reviewed the information submitted on and with this form and that it meets the requirements of the Loan Recipient's/Owner's State Revolving Fund loan contract.

(Only ONE (1) signature required below.)**

_____ Date_____
(Signature of Loan Recipient (Owner))

OR**

_____ Date_____
(Loan Recipient's (Owner's) Representative's Signature, (**P.E.**))

_____
(Printed Name and Title)

GENERAL INFORMATION:

Loan Recipient (Owner) Contact: _____

Loan Recipient (Owner) Phone Number/Email: _____

Consulting Engineer Contact: Three Notch Group, Inc., Carmen D. Chosie, P.E.

Consulting Engineer Phone Number/Email: 334-677-9431 / carmen.chosie@3notch.com

Proposed Prime Contractor: _____

Proposed Prime Contractor Contact: _____

Proposed Prime Contractor Phone Number/Email:_____

Proposed Prime Contract Amount: $ _____

Proposed Total DBE/MBE Participation: $ _____ Percentage: ____% Goal: 2.5%

Proposed Total WBE Participation: $ _____ Percentage: ____% Goal: 3.0%

_____

Please ensure the following is submitted in the *full* DBE submittal (with the DBE COMPLIANCE FORM (page SGC-8)):

(1) **List of all committed and uncommitted subcontractors** by trade, including company name, address, telephone number, contact person, dollar amount of subcontract, and DBE/MBE/WBE status. Indicate in writing if no solicitations were made because the contractor intends to use only its own forces to accomplish the work.

(2) **Proof of certification (certificate or letter)** by EPA, SBA, DOT (or by state, local, Tribal, or private entities whose certification criteria match EPA's) for each subcontractor listed as a DBE, MBE, or WBE.

(3) **Documentation of solicitation effort for prospective DBE firms**, such as fax confirmation sheets, copies of solicitation letters/emails, printout of the online solicitations, printouts of online search results, affidavits of publication in newspapers, etc. The prime contractor is strongly encouraged to follow up each written, fax, or email solicitation with at least 1 logged phone call. Whenever possible, post solicitation for bids or proposals should be for a minimum of 30 calendar days before the bid or proposal closing date.

(4) **Justification for not selecting a certified DBE subcontractor** that submitted a low bid for any subcontract area.

(5) **Certification By Proposed Prime Contractor or Subcontractor Regarding Equal Opportunity Employment. (Page SGC-24**)

(6) Debarred Firms Certification. (**Page SGC-25**)

(7) EPA Form 6100-2 DBE Subcontractor Participation Form for **each** proposed **certified** DBE subcontractor.* (**Page SGC-10**) (*This form is completed by the proposed prime contractor. It is signed by **each** proposed subcontractor **only**.)

(8) **EPA Form 6100-3 DBE Subcontractor Performance Form** for each DBE subcontractor.** (**Page SGC-12**) (**This form is completed by the proposed prime contractor and signed by each proposed certified subcontractor and the proposed prime contractor per subcontract.)

(9) **EPA Form 6100-4 DBE Subcontractor Utilization Form** to summarize all DBE subcontracts/subcontractors.*** (**Page SGC-14**) (***This form is completed and signed by the proposed prime contractor **only**.)

NOTE:

ALL DBE contractors selected must have a current DBE certificate or letter of certification by an approved certifying agency.

Loan Recipient (Owner) DBE Submittal

At minimum, the Loan Recipient (Owner)'s DBE submittal should **always** consist of **a cover letter** (*preferred, but optional*) **and a VII - DBE Compliance Form (page SGC-8) and DBE solicitation documentation** (i.e., DBE solicitation list(s) with source(s) of list(s) clearly identified, contractor contact information and results/outcomes of each solicitation (or of the overall solicitation effort, if all results/outcomes were the same), documentation of solicitation method (i.e., copies of emails, phone logs, faxes, etc.).

Prime Contractor DBE Submittal

At minimum, the Prime Contractor's DBE submittal should **always** consist of **a cover letter** (*preferred, but optional*) **and DBE solicitation documentation** (i.e., DBE solicitation list(s) with source(s) of list(s) clearly identified, subcontractor contact information and results/outcomes of each solicitation (or of the overall solicitation effort, if all results/outcomes were the same), documentation of solicitation method (i.e., copies of emails, phone logs, faxes, etc.) **OR** a "No Subcontractors" Letter (*if none will be utilized*) **and** a List of ***ALL*** *(DBE/non-DBE) subcontractors* contracted/yet to be contracted **and** ***ALL EPA 6100 Forms*** *described above* (*DBE subcontractors selected **or not***) **and** Certification Regarding Equal Employment Opportunity **and** Debarred Firms Certification.

EPA United States Environmental Protection Agency

OMB Control No: 2090-0030

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Participation Form

An EPA Financial Assistance Agreement Recipient must require its prime contractors to provide this form to its DBE subcontractors. This form gives a DBE[1] subcontractor[2] the opportunity to describe work received and/or report any concerns regarding the EPA-funded project (e.g., in areas such as termination by prime contractor, late payments, etc.). The DBE subcontractor can, as an option, complete and submit this form to the EPA DBE Coordinator at any time during the project period of performance.

Subcontractor Name		Project Name Walnut Creek Wastewater Treatment Plant Improvements
Bid/ Proposal No.	Assistance Agreement ID No. (if known) CS010835-03	Point of Contact
Address		
Telephone No.		Email Address
Prime Contractor Name		Issuing/Funding Entity: ADEM

Contract Item Number	Description of Work Received from the Prime Contractor Involving Construction, Services, Equipment or Supplies	Amount Received by Prime Contractor

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

EPA FORM 6100-2 (DBE Subcontractor Participation Form)

United States Environmental Protection Agency

OMB Control No: 2090-0030

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Participation Form

Please use the space below to report any concerns regarding the above EPA-funded project:

Subcontractor Signature	Print Name
Title	**Date**

The public reporting and recordkeeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

EPA FORM 6100-2 (DBE Subcontractor Participation Form)

EPA United States Environmental Protection Agency

OMB Control No: 2090-0030

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Performance Form

This form is intended to capture the DBE[1] subcontractor's[2] description of work to be performed and the price of the work submitted to the prime contractor. An EPA Financial Assistance Agreement Recipient must require its prime contractor to have its DBE subcontractors complete this form and include all completed forms in the prime contractors bid or proposal package.

Subcontractor Name		Project Name Walnut Creek Wastewater Treatment Plant Improvements
Bid/ Proposal No.	Assistance Agreement ID No. (if known) CS010835-03	Point of Contact
Address		
Telephone No.		Email Address
Prime Contractor Name		Issuing/Funding Entity: ADEM

Contract Item Number	Description of Work Submitted to the Prime Contractor Involving Construction, Services, Equipment or Supplies	Price of Work Submitted to the Prime Contractor

DBE Certified By: O DOT O SBA O Other: _____	Meets/ exceeds EPA certification standards? O YES O NO O Unknown

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

EPA FORM 6100-3 (DBE Subcontractor Performance Form)

United States Environmental Protection Agency

OMB Control No: 2090-0030

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Performance Form

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware of that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	Print Name
Title	**Date**

Subcontractor Signature	Print Name
Title	**Date**

The public reporting and recordkeeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

EPA FORM 6100-3 (DBE Subcontractor Performance Form)

United States Environmental Protection Agency

OMB Control No: 2090-0030

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Utilization Form

This form is intended to capture the prime contractor's actual and/or anticipated use of identified certified DBE[1] subcontractors[2] and the estimated dollar amount of each subcontract. An EPA Financial Assistance Agreement Recipient must require its prime contractors to complete this form and include it in the bid or proposal package. Prime contractors should also maintain a copy of this form on file.

Prime Contractor Name		Project Name Walnut Creek Wastewater Treatment Plant Improvements
Bid/ Proposal No.	Assistance Agreement ID No. (if known) CS010835-03	Point of Contact
Address		
Telephone No.		Email Address
Issuing/Funding Entity: ADEM		

I have identified potential DBE certified subcontractors	○ YES	◉ NO
If yes, please complete the table below. If no, please explain:		

Subcontractor Name/ Company Name	Company Address/ Phone/ Email	Est. Dollar Amt	Currently DBE Certified?

Continue on back if needed

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

EPA FORM 6100-4 (DBE Subcontractor Utilization Form)

EPA United States Environmental Protection Agency

OMB Control No: 2090-0030

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Utilization Form

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware of that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	Print Name
Title	**Date**

The public reporting and recordkeeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

EPA FORM 6100-4 (DBE Subcontractor Utilization Form)

U.S. ENVIRONMENTAL PROTECTION AGENCY
MBE/WBE UTILIZATION UNDER FEDERAL GRANTS AND COOPERATIVE AGREEMENTS

PART I OF II
(PAGES SGC-16 & SGC-17)

FOR COOPERATIVE AGREEMENTS OR OTHER FEDERAL FINANCIAL ASSISTANCE WHERE THE COMBINED TOTAL OF FUNDS BUDGETED FOR PROCURING SUPPLIES, EQUIPMENT, CONSTRUCTION OR SERVICES EXCEED $150,000.

PART 1: PLEASE REVIEW INSTRUCTIONS BEFORE COMPLETING

1A. FEDERAL FISCAL YEAR (Oct 1- Sep 30)	1B. REPORT TYPE
20_____	☐ Annual ☐ Last Report (Project completed)

1C: REVISION OF A PRIOR YEAR REPORT? ◯ No ◯ Yes, Year_____

IF YES, BRIEFLY DESCRIBE THE REVISIONS YOU ARE MAKING:

2A. EPA FINANCIAL ASSISTANCE OFFICE ADDRESS (ATTN: DBE COORDINATOR)	3A. RECIPIENT NAME AND ADDRESS
2B. EPA DBE COORDINATOR Name: Email: Phone: Fax:	3B. RECIPIENT REPORTING CONTACT Name: Address: Phone: Email:
4A. FINANCIAL ASSISTANCE AGREEMENT ID NUMBER (SRF State Recipients, refer to Instructions for Completion of blocks 4A, 5A and 5C)	4B. FEDERAL FINANCIAL ASSISTANCE PROGRAM TITLE OR CFDA NUMBER:
5A. TOTAL ASSISTANCE AGREEMENT AMOUNT EPA Share: $ _____ Recipient Share: $ _____ ☐ **N/A (SRF Recipient)/Loan Amount: $_____**	5B. If NO procurements and NO accomplishments were made this reporting period (by the recipients, sub-recipients, loan recipients, and prime contractors), **CHECK and SKIP to Block No. 7**. (Procurements are all expenditures through contract, order, purchase, lease or barter of supplies, equipment, construction, or services needed to complete Federal assistance programs. Accomplishments, in this context, are procurements made with MBEs and/or WBEs.) ☐

5C. Total Procurements This Reporting Period (Only include amount not reported in any prior reporting period)

Total Procurement Amount $_____

(Include total dollar values awarded by recipient, sub-recipients and SRF loan recipients, including MBE/WBE expenditures.)

5D. Were sub-awards issued under this assistance agreement? Yes ◯ No ◯

Were contracts issued under this assistance agreement? Yes ◯ No ◯

5E. MBE/WBE Accomplishments This Reporting Period

Actual MBE/WBE Procurement Accomplished (Include total dollar values awarded by recipient, sub-recipients, SRF loan recipients and Prime Contractors.)

	Construction	Equipment	Services	Supplies	Total
$MBE:	_____	_____	_____	_____	0.00
$WBE:	_____	_____	_____	_____	0.00

6. COMMENTS: (If no MBE/WBE procurements, please summarize how certified MBEs/WBEs were notified of the opportunities to compete for the procurement dollars entered in Block 5C and why certified MBEs /WBEs were not awarded any procurements during this reporting period.)

7. NAME OF RECIPIENT'S AUTHORIZED REPRESENTATIVE	TITLE
8. SIGNATURE OF RECIPIENT'S AUTHORIZED REPRESENTATIVE	DATE

EPA FORM 5700-52A available electronically at https://www.epa.gov/sites/production/files/2014-09/documents/epa_form_5700_52a.pdf

If reporting DBE procurement, please enter the Loan Project Number and the information in the grid below, as applicable.
If no additional DBE procurement to report, please enter the Loan Project Number and enter 'N/A' in the black box below.

PART II OF II
(PAGES SGC-16 & SGC-17)

PART II.

MBE/WBE PROCUREMENTS MADE DURING REPORTING PERIOD

SRF Financial Assistance Agreement Number: _____

1. Procurement Made By			2. Business Enterprise		3. $ Value of Procurement	4. Date of Procurement MM/DD/YY	5. Type of Product or Service (Enter Code)	6. Name/Address/Phone Number of MBE/WBE Contractor or Vendor
Recipient	Sub-Recipient and/or SRF Loan Recipient	Prime	Minority	Women				

Type of Product or Service Codes: 1 = Construction 2 = Supplies 3 = Services 4 = Equipment

Note: Recipients are required to submit MBE/WBE reports to EPA beginning with the Federal fiscal year the recipients receive the award, continuing until the project is completed.

Instructions:

A. General Instructions:

MBE/WBE utilization is based on 40 CFR Part 33. The reporting requirement reflects the class deviation issued on November 8, 2013, clarified on January 9, 2014 and modified on December 2, 2014. EPA Form 5700-52A must be completed annually by recipients of financial assistance agreements where the combined total of funds budgeted for procuring supplies, equipment, construction or services exceeds $150,000.This reporting requirement applies to all new and existing awards and voids all previous reporting requirements.

In determining whether the $150,000 threshold is exceeded for a particular assistance agreement, the analysis must focus on funds budgeted for procurement under the supplies, equipment, construction, services or "other" categories, and include funds budgeted for procurement under sub-awards or loans

Reporting will also be required in cases where the details of the budgets of sub-awards/loans are not clear at the time of the grant awards and the combined total of the procurement and sub-awards and/or loans exceeds the $150,000 threshold.

When reporting is required, all procurement actions are reportable, not just the portion which exceeds $150,000.

If at the time of award the budgeted funds exceed $150,000 but actual expenditures fall below, a report is still required.

If at the time of award, the combined total of funds budgeted for procurements in any category is less than or equal to $150,000 and is maintained below the threshold, no DBE report is required to be submitted.

Recipients are required to report 30 days after the end of each federal year, per the terms and conditions of the financial assistance agreement.

Last reports are due October 30th or 90 days after the end of the project period, whichever comes first.

MBE/WBE program requirements, including reporting, are material terms and conditions of the financial assistance agreement.

B. Definitions:

Procurement is the acquisition through contract, order, purchase, lease or barter of supplies, equipment, construction or services needed to accomplish Federal assistance programs.

A ***contract*** is a written agreement between an EPA recipient and another party (also considered "prime contracts") and any lower tier agreement (also considered "subcontracts") for equipment, services, supplies, or construction necessary to complete the project. This definition excludes written agreements with another public agency. This definition includes personal and professional services, agreements with consultants, and purchase orders.

A ***minority business enterprise*** **(MBE)** is a business concern that is (1) at least 51 percent owned by one or more minority individuals, or, in the case of a publicly owned business, at least 51 percent of the stock is owned by one or more minority

individuals; and (2) whose daily business operations are managed and directed by one or more of the minority owners. In order to qualify and participate as an MBE prime or subcontractor for EPA recipients under EPA's DBE Program, an entity must be properly certified as required by 40 CFR Part 33, Subpart B.

U.S. citizenship is required. Recipients shall presume that minority individuals include Black Americans, Hispanic Americans, Native Americans, Asian Pacific Americans, or other groups whose members are found to be disadvantaged by the Small Business Act or by the Secretary of Commerce under section 5 of Executive order 11625. The reporting contact at EPA can provide additional information.

*A **woman business enterprise*** **(WBE)** is a business concern that is, (1) at least 51 percent owned by one or more women, or, in the case of a publicly owned business, at least 51 percent of the stock is owned by one or more women and (2) whose daily business operations are managed and directed by one or more of the women owners. In order to qualify and participate as a WBE prime or subcontractor for EPA recipients under EPA's DBE Program, an entity must be properly certified as required by 40 CFR Part 33, Subpart B.

Business firms which are 51 percent owned by minorities or women, but are in fact not managed and operated by minorities or females do not qualify for meeting MBE/WBE procurement goals. U.S. Citizenship is required.

Good Faith Efforts

A recipient is required to make the following good faith efforts whenever procuring construction, equipment, services, and supplies under an EPA financial assistance agreement. These good faith efforts for utilizing MBEs and WBEs must be documented. Such documentation is subject to EPA review upon request:

1. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. For Indian Tribal, State and Local and Government recipients, this will include placing DBEs on solicitation lists and soliciting them whenever they are potential sources.

2. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitations for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.

3. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs. For Indian Tribal, State and local Government recipients, this will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.

4. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.

5. Use the services and assistance of the SBA and the Minority Business Development Agency of the Department of Commerce.

6. If the prime contractor awards subcontracts, require the prime contractor to take the steps in paragraphs (a) through (e) of this section.

C. Instructions for Part I:

1A. Specify Federal fiscal year this report covers. The Federal fiscal year runs from October 1st through September 30th (**e.g. November 29, 2014 falls within Federal fiscal year 2015**)

1B. Specify report type. Check the annual reporting box. Also indicate if the project is completed.

1C. Indicate if this is a revision to a previous year and provide a brief description of the revision you are making.

2A-B. Please refer to your financial assistance agreement for the mailing address of the EPA financial assistance office for your agreement.

The "EPA DBE Reporting Contact" is the DBE Coordinator for the EPA Region from which your financial assistance agreement was originated. For a list of DBE Coordinators please refer to the EPA OSBP website at http://epa.gov/osbp/dbe_cord.

3A-B. Identify the agency, state authority, university or other organization which is the recipient of the Federal financial assistance and the person to contact concerning this report.

4A. Provide the Assistance Agreement number assigned by EPA. A separate report must be submitted for each Assistance Agreement.

***For SRF recipients**: In box 4a list numbers for ALL OPEN Assistance Agreements being reported on this form.

4B. Refer back to Assistance Agreement document for this information.

5A. Provide the total amount of the Assistance Agreement which includes Federal funds plus recipient matching funds and funds from other sources.

***For SRF recipients only**: SRF recipients will not enter an amount in 5a. SRF recipients should check the "N/A" box.

5B. Self-explanatory.

5C. Provide the total dollar amount of **ALL** procurements awarded this reporting period by the recipient, sub-recipients, and SRF loan recipients, **including** MBE/WBE expenditures, not just the portion which exceeds $150,000. For example: Actual dollars for procurement from the procuring office; actual contracts let from the contracts office; actual goods, services, supplies, etc., from other sources including the central purchasing/ procurement centers).

***NOTE**: To prevent double counting on line 5C, if any amount on 5E is for a subcontract and the prime contract has already been included on Line 5C in a prior reporting period, then report the amount going to MBE or WBE subcontractor on line 5E, but exclude the amount from Line 5C. To include the amount on 5C again would result in double counting because the prime contract, which includes the subcontract, would have already been reported.

***For SRF recipients only**: In 5c please enter the total annual procurement amount under all of your SRF Assistance Agreements. The figure reported in this section is **not** directly tied to an individual Assistance Agreement identification number. **(SRF state recipients report state procurements in this section)**

5D. State whether or not sub-awards and/or subcontracts have been issued under the financial assistance agreements by indicating “yes” or “no”.

5E. Where requested, also provide the total dollar amount of all MBE/WBE procurement awarded during this reporting period by the recipient, sub-recipients, SRF loan recipients, and prime contractors in the categories of construction, equipment, services and supplies. These amounts include Federal funds plus recipient matching funds and funds from other sources.

6. If there were no MBE/WBE accomplishments this reporting period, please briefly how certified MBEs/WBEs were notified of the opportunities to compete for the procurement dollars entered in Block 5C and why certified MBEs /WBEs were not awarded any procurements during this reporting period.

7. Name and title of official administrator or designated reporting official.

8. Signature, month, day, and year report submitted.

D. Instructions for Part II:

For each MBE/WBE procurement made under this financial assistance agreements during the reporting period, provide the following information:

1. Check whether this procurement was made by the recipient, sub-recipient/SRF loan recipient, or the prime contractor.

2. Check either the MBE or WBE column. If a firm is both an MBE and WBE, the recipient may choose to count the entire procurement towards EITHER its MBE or WBE accomplishments. The recipient may also divide the total amount of the procurement (using any ratio it so chooses) and count those divided amounts toward its MBE and WBE accomplishments. If the recipient chooses to divide the procurement amount and count portions toward its MBE and WBE accomplishments, please state the appropriate amounts under the MBE and WBE columns on the form. **The combined MBE and WBE amounts for that MBE/WBE contractor must not exceed the “Value of the Procurement” reported in column #3**

3. Dollar value of procurement.

4. Date of procurement, shown as month, day, year. Date of procurement is defined as the date the contract or procurement was awarded, **not** the date the contractor received payment under the awarded contract or procurement, unless payment occurred on the date of award. **(Where direct purchasing is the procurement method, the date of procurement is the date the purchase was made)**

5. Using codes at the bottom of the form, identify type of product or service acquired through this procurement (e.g., enter 1 if construction, 2 if supplies, etc.).

6. Name, address, and telephone number of MBE/WBE firm.

**This data is requested to comply with provisions mandated by: statute or regulations (40 CFR Parts 30, 31, and 33 and/or 2 CFR Parts 200 and 1500); OMB Circulars; or added by EPA to ensure sound and effective assistance management. Accurate, complete data are required to obtain funding, while no pledge of confidentiality is provided.

The public reporting and recording burden for this collection of information is estimated to average l hour per response annually. Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclosure or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, OPPE Regulatory Information Division, U.S. Environmental Protection Agency (2136), 1200 Pennsylvania Avenue, NW, Washington, D.C. 20460. Include the OMB Control number in any correspondence. Do not send the completed form to this address.

XII – Changes to Approved DBE Compliance Form

NOTE: THIS FORM IS REQUIRED OF THE LOAN RECIPIENT (OWNER) (WITH THE PRIME CONTRACTOR'S INPUT) FOR DBE COMPLIANCE ONLY IF A SUBCONTRACTOR/SUPPLIER/VENDOR IS SOUGHT AND/OR PROCURED AFTER THE CONTRACT ATA (APPROVAL-TO-AWARD) HAS BEEN ISSUED. IT IS SIMILAR TO THE DBE COMPLIANCE FORM (PAGE SGC-8) IN THAT IT IS THE COVER/SUMMARY FORM USED TO DOCUMENT THE ADDITIONAL DBE SOLICITATION AND/OR REVISE THE ORIGINAL DBE APPROVAL STATUS.

Loan Recipient: City of Troy Loan (Project) Number: CS010835-03 ____

CERTIFICATIONS:

I certify that the information submitted on and with this form is true and accurate and that this company has met and will continue to meet the conditions of this construction contract regarding DBE solicitation and utilization. I further certify that criteria used in selecting subcontractors and suppliers were applied equally to all potential participants and that EPA Forms 6100-2 and 6100-3 were distributed to all DBE subcontractors.

_____ Date_____
(Prime Contractor Signature)

_____
(Printed Name and Title)

I certify that I have reviewed the information submitted on and with this form and that it meets the requirements of the Loan Recipient's/Owner's State Revolving Fund loan contract. **(*Only ONE (1) signature required below.)**

_____ Date_____
(Signature of Loan Recipient (Owner))

OR*

_____ Date_____
(Loan Recipient's (Owner's) Representative's Signature, (**P.E.**))

_____
(Printed Name and Title)

GENERAL INFORMATION: **(Please attach additional pages to address 1 through 5, as needed.)**

(1) If an approved subcontractor is terminated or replaced, please identify this company and briefly state the reason.

(2) For new or additional subcontractors, list name, trade, address, telephone number, contact person, dollar amount of subcontract and DBE status.

(3) Attach proof of certification by EPA, SBA, DOT (or by state, local, Tribal or private entities whose certification criteria match EPA's) for each subcontractor listed as a DBE, MBE or WBE.

(4) Attach documentation of solicitation effort for prospective DBE firms, such as fax confirmation sheets, copies of solicitation letters/emails, printouts of the online solicitations, printouts of online search results, affidavits of publication in newspapers, etc. The prime contractor is strongly encouraged to follow up each solicitation with, at least, one (1) logged phone call. Whenever possible, post solicitation for bids or proposals should be for a minimum of 30 calendar days before the bid or proposal closing date.

(5) Provide justification for not selecting a certified DBE subcontractor that submitted a low bid for any subcontract area.

XIII – Certification Regarding Equal Employment Opportunity

The prime contractor is required to comply with Executive Order 112-46 of September 24, 1965 entitled "Equal Employment Opportunity" as amended by Executive Order 11375 of October 13, 1967.

The contract for the work under this proposal will obligate the prime contractor and its subcontractors not to discriminate in employment practices.

The prime contractor shall not maintain or provide for his/her employees the facilities, which are segregated on a basis of race, creed, color or national origin, whether such facilities are segregated by directive or on a de facto basis.

The prime contractor must, if requested, submit a compliance report concerning their employment practices and policies in order to maintain his/her eligibility to receive the award of the contract.

The prime contractor must be prepared to comply in all respects with any contract provisions regarding non-discrimination stipulated in conjunction with labor standards.

PRIME CONTRACTOR'S CERTIFICATION:

Prime Contractor's Name: _____

Address: _____

_____

_____

1. Bidder has participated in a previous contract or subcontract subject to the Equal Opportunity Clause. Yes____ No____
2. Compliance Reports were required to be filed in connection with such contract or subcontract. Yes____ No____
3. Bidder has filed all compliance reports due under applicable contract requirements. Yes____ No____

If answer to item 3 is "No", please explain in detail on reverse side of this certification.

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

Signature of Prime Contractor: _____

Title: _____

Date: _____

XIV – Debarred Firms Certification

All prime construction contractors shall certify that Subcontracts have not and will not be awarded to any firm that is currently on the General Service Administration's Master List of Debarred, Suspended and Voluntarily Excluded Persons, in accordance with the provisions of ADEM Administrative Code 335-6-14-.35. Debarment action is taken against a firm for noncompliance with Federal Law.

All bidders shall complete this certification in duplicate and submit both copies to the Loan Recipient (Owner) with the bid proposal. The Loan Recipient (Owner) shall transmit one copy to the SRF Section within 14 days after the bid opening.

Project Name/Loan Name*: Walnut Creek Wastewater Treatment Plant Improvements
(*not **Contract** Name)

SRF Project No.: CS010835-03

The undersigned hereby certifies that the firm of _____

_____ has not and will not award a subcontract, in connection with any contract awarded to it as the result of this bid, to any firm that is currently on the General Service Administration's Master List of Debarred, Suspended, and Voluntarily Excluded Persons.

Signature of Prime Contractor: _____

Title: _____

Date: _____

XV – Davis-Bacon and Related Acts

Labor Standards Provisions for Federally Assisted Contracts

Wage Rate Requirements Under FY 2013 Continuing Appropriation

I. Requirements under the Consolidated and Further Continuing Appropriations Act. 2013 (P.L. 113-6) For Subrecipients That Are Governmental Entities:

The following terms and conditions specify how recipients will assist EPA in meeting its Davis-Bacon (DB) responsibilities when DB applies to EPA awards of financial assistance under the FY 2013 Continuing Resolution with respect to State recipients and subrecipients that are governmental entities. If a subrecipient has questions regarding when DB applies, obtaining the correct DB wage determinations, DB provisions, or compliance monitoring, it may contact the State recipient. If a State recipient needs guidance, the recipient may contact Cynthia Y. Edwards at Edwards.Cynthiay@epa.gov or at 404-562-9340 of EPA, Region 4 Grants and SRF Management Section, for guidance. The recipient or subrecipient may also obtain additional guidance from DOL's web site at http://www.dol.gov/whd/

1. Applicability of the Davis- Bacon (DB) prevailing wage requirements.

Under the FY 2013 Continuing Resolution, DB prevailing wage requirements apply to the construction, alteration, and repair of treatment works carried out in whole or in part with assistance made available by a State water pollution control revolving fund and to any construction project carried out in whole or in part by assistance made available by a drinking water treatment revolving loan fund. If a subrecipient encounters a unique situation at a site that presents uncertainties regarding DB applicability, the subrecipient must discuss the situation with the recipient State before authorizing work on that site.

2. Obtaining Wage Determinations.

(a) Subrecipients shall obtain the wage determination for the locality in which a covered activity subject to DB will take place prior to issuing requests for bids, proposals, quotes or other methods for soliciting contracts (solicitation) for activities subject to DB. These wage determinations shall be incorporated into solicitations and any subsequent contracts. Prime contracts must contain a provision requiring that subcontractors follow the wage determination incorporated into the prime contract.

(i) While the solicitation remains open, the subrecipient shall monitor www.wdol.gov weekly to ensure that the wage determination contained in the solicitation remains current. The subrecipients shall amend the solicitation if DOL issues a modification more than 10 days prior to the closing date (i.e. bid opening) for the solicitation. If DOL modifies or supersedes the applicable wage determination less than 10 days prior to the closing date, the subrecipients may request a finding from the State recipient that there is not a reasonable time to notify interested contractors of the modification of the wage determination. The State recipient will provide a report of its findings to the subrecipient.

(ii) If the subrecipient does not award the contract within 90 days of the closure of the solicitation, any modifications or supersedes DOL makes to the wage determination contained in the solicitation shall be effective unless the State recipient, at the request of the subrecipient, obtains an extension of the 90 day period from DOL pursuant to 29 CFR 1.6(c)(3)(iv). The subrecipient shall monitor www.wdol.gov on a weekly basis if it does not award the contract within 90 days of closure of the solicitation to ensure that wage determinations contained in the solicitation remain current.

(b) If the subrecipient carries out activity subject to DB by issuing a task order, work assignment or similar instrument to an existing contractor (ordering instrument) rather than by publishing a solicitation, the subrecipient shall insert the appropriate DOL wage determination from www.wdol.gov into the ordering instrument.

(c) Subrecipients shall review all subcontracts subject to DB entered into by prime contractors to verify that the prime contractor has required its subcontractors to include the applicable wage determinations.

(d) As provided in 29 CFR 1.6(f), DOL may issue a revised wage determination applicable to a subrecipient's contract after the award of a contract or the issuance of an ordering instrument if DOL determines that the subrecipient has failed to incorporate a wage determination or has used a wage determination that clearly does not apply to the contract or ordering instrument. If this occurs, the subrecipient shall either terminate the contract or ordering instrument and issue a revised solicitation or ordering instrument or incorporate DOL's wage determination retroactive to the beginning of the contract or ordering instrument by change order. The subrecipient's contractor must be compensated for any increases in wages resulting from the use of DOL's revised wage determination.

3. Contract Subcontract Provisions.

(a) The Recipient shall insure that the subrecipient(s) shall insert in full in any contract in excess of $2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a treatment work under the CWSRF or a construction project under the DWSRF financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in § 5.1 or the FY 2010 appropriation , the following clauses:

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

Subrecipients may obtain wage determinations from the U.S. Department of Labor's web site, www.dol.gov.

(ii)(A) The subrecipient(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The State award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the subrecipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the subrecipient (s) to the State award official. The State award official will transmit the request, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the State award official or will notify the State award official within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the subrecipient(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding.

The subrecipient(s), shall upon written request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the subrecipient, that is, the entity that receives the sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the subrecipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at https://www.dol.gov/agencies/whd/forms/wh347 or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the subrecipient(s) for transmission to the State or EPA if requested by EPA , the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the subrecipient(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the State, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program.

If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements.

The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts.

The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may by appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination: debarment.

A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements.

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards.

Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and Subrecipient(s), State, EPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

4. Contract Provision for Contracts in Excess of $100,000.

(a) Contract Work Hours and Safety Standards Act. The subrecipient shall insert the following clauses set forth in paragraphs (a)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Item 3, above or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements.

No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages.

In the event of any violation of the clause set forth in paragraph (a)(1) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (a)(1) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (a)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages.

The subrecipient, upon written request of the EPA Award Official or an authorized representative of the Department of Labor, shall withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) Subcontracts.

The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (a)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (a)(1) through (4) of this section.

(b) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the Subrecipient shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Subrecipient shall insert in any such contract a clause providing hat the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

5. Compliance Verification

(a) The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.

(b) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, the subrecipient should conduct interviews with a representative group of covered employees within two weeks of each contractor or subcontractor's submission of its initial weekly payroll data and two weeks prior to the estimated completion date for the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information
indicates that there is a risk that the contractor or subcontractor is not complying with DB. Subrecipients shall immediately conduct necessary interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence.

(c) The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable, the subrecipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract . Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments there under by contractors and subcontractors who claim credit for fringe benefit contributions.

(d) The subrecipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(e) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB contact listed above and to the appropriate DOL Wage and Hour District Office listed at https://www.dol.gov/agencies/whd/contact/local-offices.

(Insert applicable wage rate determination here.)

Wage Rates are county specific for *Heavy Construction* and can be found at:
https://sam.gov/content/wage-determinations

"General Decision Number: AL20250001 02/07/2025

State: Alabama

Construction Type: Heavy Dredging

Counties: Alabama Statewide.

DREDGING CONSTRUCTION PROJECTS (SELF-PROPELLED HOPPER DREDGING ONLY).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	• Executive Order 14026 generally applies to the contract. • The contractor must pay all covered workers at least $17.75 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2025.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	• Executive Order 13658 generally applies to the contract. • The contractor must pay all covered workers at least $13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours performing on that contract in 2025.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at http://www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	02/07/2025

SUAL1998-001 03/26/1998

The following rates were revised pursuant to 29 CFR 1.6(c)(1) on 02/07/2025.

	Rates	Fringes
Self-Propelled Hopper Dredge		
Drag Tenders	$ 20.36	7.24+b

FOOTNOTES: b.- Fourteen days paid vacation and eight paid holidays: New Year's Day; Good Friday; Memorial Day; Independence Day; Labor Day; Veteran's Day; Thanksgiving Day and Christmas Day, provided that employee has had one year or more of service.

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

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 clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for

this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The ""SU"" identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

a) a survey underlying a wage determination
b) an existing published wage determination
c) an initial WHD letter setting forth a position on a wage determination matter
d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

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END OF GENERAL DECISION"

XVI – American Iron and Steel Requirement

Section 4.13 Compliance with 2014 Appropriations Act. (a) The Loan Recipient agrees to comply with all federal requirements applicable to the Authority Loan (including those imposed by P.L. 113-76, Consolidated Appropriations Act (the "2014 Appropriations Act") and related SRF Policy Guidelines) which the Loan Recipient understands includes, among other things, requirements that all of the iron and steel products used in the Project are to be produced in the United States ("American Iron and Steel") unless (i) the Loan Recipient has requested and obtained a waiver from the U.S. Environmental Protection Agency pertaining to the Project or (ii) the Authority has otherwise advised the Loan Recipient in writing that the Buy American Requirement is not applicable to the Project. .

(b) The Loan Recipient also agrees to comply with all recordkeeping and reporting requirements under the Clean Water Act (codified generally under 33 U.S.C. §1251 et seq.) (the "Clean Water Act"), including any reports required by a federal agency or the Authority such as performance indicators of program deliverables, information on costs and Project progress. The Loan Recipient understands that (i) each contract and subcontract related to the Project is subject to audit by appropriate federal and state entities, and (ii) failure to comply with the Clean Water Act and this Agreement may be an Event of Default hereunder that results in a repayment of the Authority Loan in advance of the maturity of the Evidence of Indebtedness and/or other remedial actions.

The Loan Recipient agrees to cause all contractors and subcontractors to comply with (through the inclusion of appropriate terms and conditions in all contracts, subcontracts and lower tiered transactions, such terms and conditions to be in substantially the form set forth in connection with the development and construction of the project

The Contractor acknowledges to and for the benefit of the City of Troy, Alabama ("Purchaser"), and the Alabama Water Pollution Control Authority or the Drinking Water Finance Authority (the "State Authority") that it understands the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund that have statutory requirements commonly known as "American Iron and Steel;" that requires all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel") including iron and steel products provided by the Contractor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State Authority that (a) the Contractor has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Purchaser or the State Authority. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State Authority to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Purchaser or State Authority resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State Authority or any damages owed to the State Authority by the Purchaser). While the Contractor has no direct contractual privity with the State Authority, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State Authority is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State Authority.

XVII – Build America, Buy America (BABA) Requirement

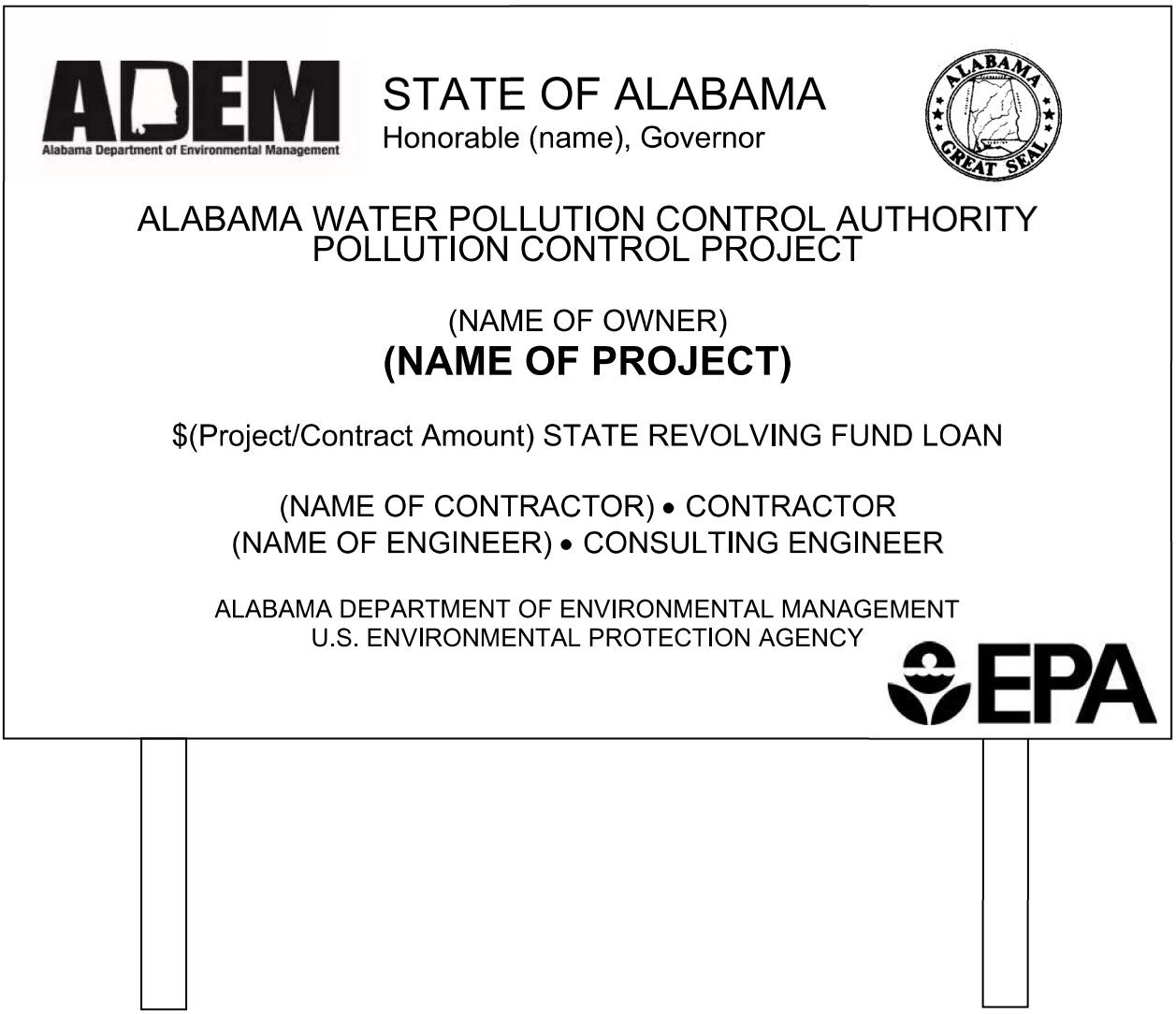
Comply with all federal requirements applicable to the assistance received (including those imposed by the Infrastructure Investment and Jobs Act ("IIJA"), Public Law No. 117-58) which the Participant understands includes, but is not limited to, the following requirements: that all of the iron and steel, manufactured products, and construction materials used in the Project are to be produced in the United States ("Build America, Buy America Requirements") unless (i) the Participant has requested and obtained a waiver from the cognizant Agency[1] pertaining to the Project or the Project is otherwise covered by a general applicability waiver; or (ii) all of the contributing Agencies have otherwise advised the Participant in writing that the Build America, Buy America Requirements are not applicable to the Project. Comply with all record keeping and reporting requirements under all applicable legal authorities, including any reports required by the funding authority (such as EPA and/or a state), such as performance indicators of program deliverables, information on costs and project progress. The Participant understands that (i) each contract and subcontract related to the Project is subject to audit by appropriate federal and state entities and (ii) failure to comply with the applicable legal requirements and this Agreement may result in a default hereunder that results in a repayment of the assistance agreement in advance of the maturity of the Bonds, termination and/or repayment of grants, cooperative agreements, direct assistance or other types of financial assistance, and/or other remedial actions.

ALL CONSTRUCTION CONTRACTS MUST HAVE A CLAUSE REQUIRING COMPLIANCE WITH THE BABA REQUIREMENTS. The loan recipient agrees to cause all contractors and subcontractors to comply with (through the inclusion of appropriate terms and conditions in all contracts, subcontracts, and lower tiered transactions) such terms and conditions to be in substantially the form set forth in connection with the development and construction of the project.

The Contractor acknowledges to and for the benefit of the City of Troy ("Owner") and the ADEM (the "Funding Authority") that it understands the goods and services under this Agreement are being funded with federal monies and have statutory requirements commonly known as "Build America, Buy America;" that requires all of the iron and steel, manufactured products, and construction materials used in the project to be produced in the United States ("Build America, Buy America Requirements") including iron and steel, manufactured products, and construction materials provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Owner and Funding Authority (a) the Contractor has reviewed and understands the Build America, Buy America Requirements, (b) all of the iron and steel, manufactured products, and construction materials used in the project will be and/or have been produced in the United States in a manner that complies with the Build America, Buy America Requirements, unless a waiver of the requirements is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the Build America, Buy America Requirements, as may be requested by the Owner or the Funding Authority. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Owner or Funding Authority to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Owner or Funding Authority resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part,

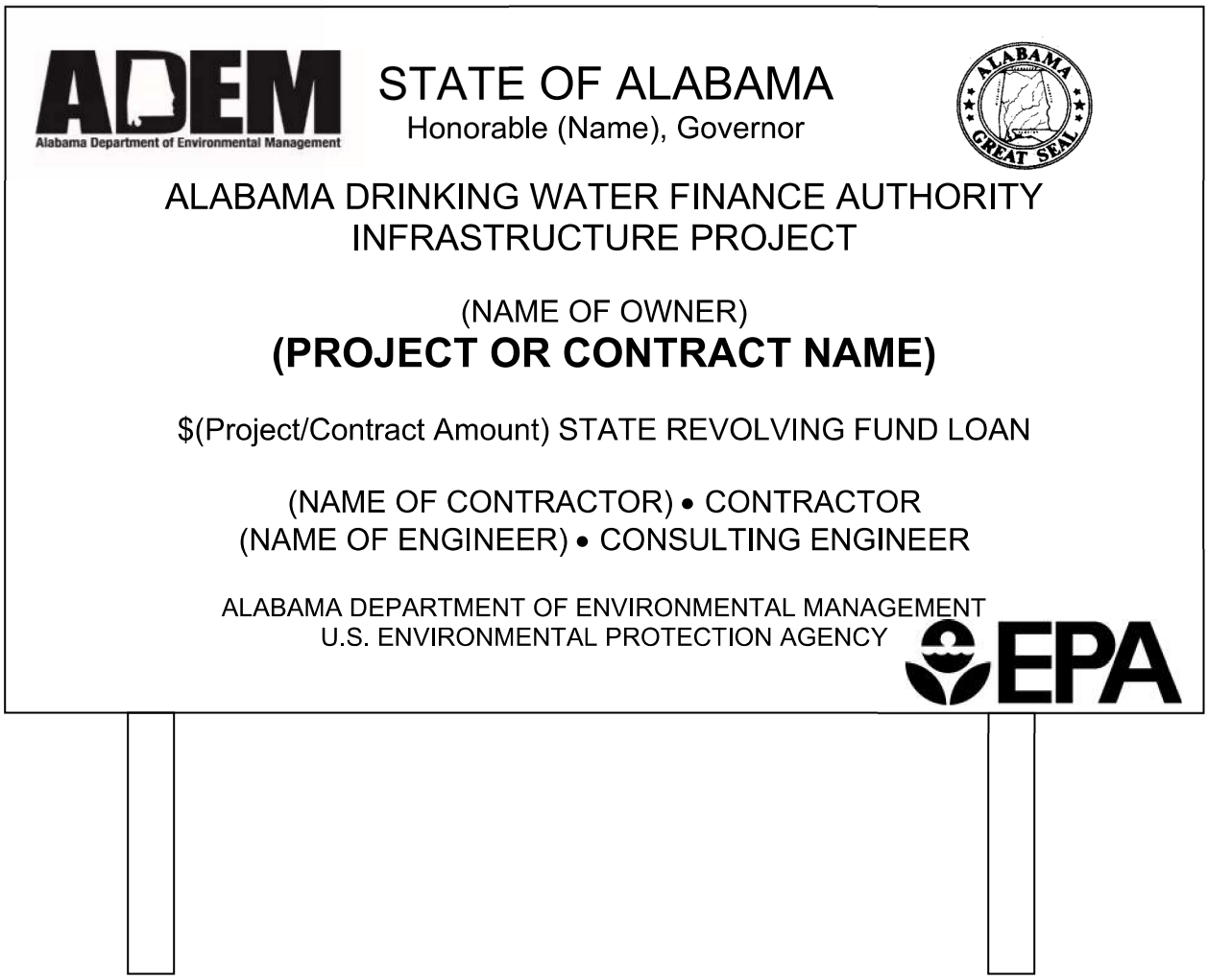
from the Funding Authority or any damages owed to the Funding Authority by the Owner). If the Contractor has no direct contractual privity with the Funding Authority, as a lender or awardee to the Owner for the funding of its project, the Owner and the Contractor agree that the Funding Authority is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the Funding Authority.

XVII – Project Sign Detail - CWSRF



1. Sign is to be constructed of ½" MDO plywood, 4' x 8'. Alternate materials may be used if approved by ADEM prior to use.
2. Paint with two (2) coats oil-base enamel before lettering.
3. Background color white; lettering black.
4. Lettering may be painted or vinyl. All lettering sizes to be proportionate to sign layout.
5. Sign shall be attached to 4" x 4" x 8' treated posts. Alternatives may be used if approved by ADEM prior to use.
6. Sign shall be placed in prominent location, easily readable from existing street or roadway.
7. Sign shall be maintained in good condition until completion of project.

XVIII – Project Sign Detail - DWSRF



1. Sign is to be constructed of ½" MDO plywood, 4' x 8'. Alternate materials may be used if approved by ADEM prior to use.
2. Paint with two (2) coats oil-base enamel before lettering.
3. Background color white; lettering black.
4. Lettering may be painted or vinyl. All lettering sizes to be proportionate to sign layout.
5. Sign shall be attached to 4" x 4" x 8' treated posts. Alternatives may be used if approved by ADEM prior to use.
6. Sign shall be placed in prominent location, easily readable from existing street or roadway.
7. Sign shall be maintained in good condition until completion of project.

STATE OF ALABAMA
Honorable (Name), Governor

ALABAMA AMERICAN RESCUE PLAN ACT (ARPA)
DRINKING WATER / WASTEWATER PROJECT INFRASTRUCTURE

(NAME OF OWNER)

(NAME OF PROJECT)

$(amount) ARPA Funds
$(amount) State Revolving Fund Loan (if applicable)

(NAME OF CONTRACTOR) • CONTRACTOR
(NAME OF ENGINEER) • CONSULTING ENGINEER

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

XIX – Construction Contract Requirements

This checklist is to be completed by the Loan Recipient (Owner)/Engineer when submitting plans and specifications to the SRF Section for review. It affirms to the SRF reviewer that the Loan Recipient (Owner)/Engineer has addressed these items (in boilerplate form) within the specifications manual.

Contract Page No.	Satisfied Yes/No	
00105-1 to 00105-2	Yes	Bid Advertisement (including date, time, and location of bid opening).
00410-1 to 00410-2	Yes	Bid Bond.
00610-1 to 00610-2	Yes	Performance Bond (100%).
00620-1 to 00620-2	Yes	Payment Bond (Not less than 50%).
00500-1	Yes	Contract Length.
00500-2	Yes	Liquidated Damages.
00700-14 to 00700-18	Yes	Liability Insurance (including workman's comp, public liability, and builder's risk, if applicable).
00200-6	Yes	Method of Award (i.e. lowest, responsive, responsible bidder).
N/A	N/A	Air testing of gravity sewers (if applicable).

Within 14 days after the bid opening, the Loan Recipient (Owner)/Engineer is to prepare the Project Review and Cost Summary (per the **PR&CS Checklist, page SGC-39**) and submit it to the SRF Section of ADEM. Upon completion of review, a *written* ATA (Approval-to-Award) will be issued.

NOTE:

The Loan Recipient (Owner) assumes all financial risk, if the construction contract is awarded prior to the issuance of an ATA letter by the SRF Section.

XX – Project Review and Cost Summary

ADEM Alabama Department of Environmental Management	SRF Project Review and Cost Summary	Form Revised **07-2021**

This form is to be completed and submitted (with supporting documentation) to the SRF Section within 14 days after bid opening. Following satisfactory review, an ATA (Approval-to-Award) letter will be issued. After the ATA is issued/ award of the contract, a pre-construction conference should be scheduled (**with the SRF Project Manager in attendance**). *A complete, bound set of the executed contract documents manual should be forwarded to the SRF Section for review and written approval following the pre-construction conference.*

Loan Recipient: City of Troy Project Number: CS010835-03

Project Name: Walnut Creek Wastewater Treatment Plant Improvements

Contract Number: _____ Contract Name: _____

1. Date of plans and specifications concurrence letter from ADEM-SRF Section: _____

   Date of construction permit issuance from ADEM-DW Branch: _____

2. Attach copies of the following documents:

___ a. Bid advertisement with certification by publisher and date(s) of publication.

___ b. Certified bid tabulation.

___ c. Proposal of the selected bidder.

___ d. Bid bond.

___ e. Engineer's letter to the loan recipient recommending award of the contract. If the award is made to other than the low bidder, provide justification.

___ f. Site certificates for the project, if not previously submitted with the SRF loan application.

___ g. DBE Documentation from **the loan recipient (owner) and the prime contractor**. Utilization, solicitation and documentation requirements (with a list of required documents) are discussed in detail in Parts III - V (pages SGC-3 - SGC-23) of the ADEM *SRF Supplemental General Conditions* for SRF Assisted Public Drinking Water and Wastewater Facilities Construction Contracts.

___ h. Copy of the wage determination used in bidding.

___ i. Any addenda that have been issued after ADEM review of the plans and specifications.

Comments:

_____

_____

SECTION 01100

SUMMARY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Contract description.

B. Work by Owner.

C. Owner supplied products.

D. Contractor's use of site and premises.

E. Future work.

F. Work sequence.

G. Owner occupancy.

H. Specification Conventions.

1.2 CONTRACT DESCRIPTION

A. Work of the Project is as described in Contract Drawings and Documents.

B. Perform Work of each Contract under separate contract with Owner in accordance with Conditions of Contract.

1.3 WORK BY OWNER OR OTHERS

A. Items to be furnished and installed by Owner and/or Others are as noted in the Drawings.

1.4 OWNER SUPPLIED PRODUCTS

A. Owner's Responsibilities:
   1. Arrange for and deliver Engineer-reviewed Shop Drawings, Product Data, and Samples, to Contractor.
   2. Arrange and pay for delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:
   1. Review Owner-reviewed Shop Drawings, Product Data, and Samples.

2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
3. Handle, store, install and finish products.
4. Repair or replace items damaged after receipt.

C. Products furnished to site and installed by Owner:
1. As noted on Drawings or Special Provisions

D. Items furnished by Owner for installation by Contractor:
1. As noted on Drawings or Special Provisions

1.5 CONTRACTOR'S USE OF SITE AND PREMISES

A. Limit use of site and premises to allow:
1. Owner occupancy.
2. Work by Others and Work by Owner.

B. Access to Site: Limited to construction activities

C. Construction Operations: Limited to work described in the Technical Specifications.

D. Time Restrictions for Performing Work: Limits of the Agreement.

1.6 WORK SEQUENCE

A. Construct Work in stages to accommodate Owner's occupancy requirements during construction period. Coordinate construction schedule and operations with Owner and Engineer. Additional sequences may be indicated in the Drawings.

1.7 OWNER OCCUPANCY

A. The Owner will occupy the site during the entire period of construction for the conduct of normal operations.

B. Cooperate with Owner to minimize conflict, and to facilitate Owner's operations.

C. Schedule the Work to accommodate Owner occupancy.

1.8 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words “shall be” are included by inference where a colon (:) is used within sentences or phrases.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01200

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Schedule of values.

B. Applications for payment.

C. Change procedures.

D. Defect assessment.

E. Unit prices.

F. Alternates.

1.2 SCHEDULE OF VALUES

A. Submit printed schedule on Contractor's standard form or electronic media printout.

B. Submit Schedule of Values in duplicate within 15 days after date established in Notice to Proceed.

C. Include in each line item, amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by unit cost to achieve total for each item.

D. Revise schedule to list approved Change Orders, with each Application for Payment.

1.3 APPLICATIONS FOR PAYMENT

A. Submit four copies of each application on Contractor's electronic media driven form.

B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.

C. Submit updated construction schedule with each Application for Payment.

D. Payment Period: Contractor to submit Pay Request, with the agreed upon quantities shown, on the first working day of the month for the previous month.

E. Submit with transmittal letter as specified for Submittals in Section 01330.

F. Substantiating Data: When submitting Pay Request that includes a pay request for stored materials, Contractor must also submit a paid invoice for all materials listed for reimbursement.

1.4 CHANGE PROCEDURES

A. Submittals: Submit name of individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

B. The Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions.

C. Contractor may propose changes by submitting a request for change to Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors.

D. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's fixed price quotation.

E. Unit Price Change Order: For contract unit prices and quantities, the Change Order will be executed on fixed unit price basis.

F. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.

G. Correlation Of Contractor Submittals:
1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
3. Promptly enter changes in Project Record Documents.

1.5 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the Engineer, it is not practical to remove and replace the Work, the Engineer will direct appropriate remedy or adjust payment.

C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Engineer.

D. Defective Work will be partially repaired to instructions of Engineer, and unit sum/price will be adjusted to new sum/price at discretion of Engineer.

E. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.

F. Authority of Engineer to assess defects and identify payment adjustments is final.

G. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Products not completely unloaded from transporting vehicle.
   4. Products placed beyond lines and levels of required Work.
   5. Products remaining on hand after completion of the Work.
   6. Loading, hauling, and disposing of rejected products.

1.6 UNIT PRICES

A. Authority: Measurement methods are delineated in Section 1.7 of this Specification.

B. Measurement methods delineated in individual specification sections complement criteria of this section. In event of conflict, requirements of individual specification section govern.

C. Take measurements and compute quantities. Engineer will verify measurements and quantities.

D. Unit Quantities: Quantities and measurements indicated in Bid Form are for contract purposes only. Quantities and measurements supplied or placed in the Work shall determine payment.
   1. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at unit sum/prices contracted.

E. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application or installation of item of the Work; overhead and profit.

F. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Engineer multiplied by unit sum/price for Work incorporated in or made necessary by the Work.

1.7 EXPLANATION OF BID ITEMS

A. **Bid Item No. 1 – Mobilization** – See Specification Section 02050.

B. **Bid Item No. 2 – Influent Lift Station Plug Valve and Base Elbow Replacement** – Includes furnishing all labor, materials and equipment to complete the replacement of existing twelve 12-inch plug valve and 12-inch base elbow at the influent lift station. Also includes bypass pumping, as required. Payment will be made per each elbow replaced and shall include any incidentals necessary to complete the work in accordance with these plans and specifications.

C. **Bid Item No. 3 – Filtration Equipment** – Includes furnishing all labor, materials and equipment to install new packaged lift stations as outlined in Section 11217 and shown on Drawings, new cloth media disc filtration equipment in stainless steel tankage in accordance with Section 13200 and shown on Drawings, and new packaged granular media and resin filter system in accordance with Section 13250 and shown on Drawings, and all associated appurtenances, site improvements, concrete support slabs, pipe improvements, and support processes outlined in the Contract Documents. Payment will be made at the contract lump sum price bid and shall include any incidentals necessary to complete the work in accordance with the plans and specifications.

D. **Bid Item No. 4 – Ultraviolet Disinfection Equipment Replacement** – Includes furnishing all labor, materials and equipment to remove and properly dispose of existing ultraviolet disinfection equipment and install new horizontal ultraviolet disinfection equipment in accordance with Section 11345. Work shall include cleaning and modifications to the existing concrete structure, including new 24-inch slide gate, and aluminum grating to support disinfection system installation and ancillary piping and/or equipment required to provide a complete and properly operation system. Payment shall be Lump Sum.

E. **Bid Item No. 5 – Dewatering Equipment Improvements –** Includes furnishing all labor, materials, and equipment necessary to install dewatering equipment as outlined in Section 11300 and shown on Drawings, metal awning, and all associated appurtenances, site improvements, pipe improvements, and support processes outlined in the Contract Documents. Payment will be made at the contract lump sum price bid and shall include any incidentals necessary to complete the work in accordance with the plans and specifications.

1.8 ALTERNATES

A. **Alternate No. 1 (Additive) – Emergency Standby Generator with ATS and Concrete Pad –** Includes providing all labor and furnishing all equipment and tools to install a standby generator system with automatic transfer switch and concrete equipment pad with associated wiring and other appurtenances required to form a complete and functioning system as shown on Drawings. Payment will be made at the contract lump sum price bid and shall include any incidentals necessary to complete the work in accordance with these plans and specifications.

B. **Alternate No. 2 (Additive) – Influent Lift Station Rehabilitation –** Includes furnishing all labor, materials and equipment to remove and properly dispose of out of service recirculation pump and piping as shown on Drawings , pressure wash and clean dry pit, and coat discharge piping in accordance with Section 09900. Payment will be made at the contract lump sum price bid and shall include any incidentals necessary to complete the work in accordance with these plans and specifications.

C. **Alternate No. 3 (Additive)– Oxidation Ditch Slide Gate Replacement** – Includes furnishing all labor, materials and equipment to complete the installation of a face mounted 48-inch slide gate from the existing grit channel to Oxidation Ditch No. 2. Includes removal (as applicable) and replacement of existing frame, seal, stem, slide, manual lift and

operator. Payment will be made at the contract lump sum price bid and shall include any incidentals necessary to complete the work in accordance with these plans and specifications.

D. **Alternate No. 4 (Additive) – Clarifier Splitter Box Slide Gate Replacement** – Includes furnishing all labor, materials and equipment to complete the installation of a face mounted 24-inch slide gate from the existing clarifier splitter box to Clarifier No. 2. Includes removal (as applicable) and replacement of existing frame, seal, stem, slide, manual lift and operator. Payment will be made at the contract lump sum price bid and shall include any incidentals necessary to complete the work in accordance with these plans and specifications.

E. **Alternate No. 5 (Additive) – Septage/Grit Receiving Pit Rehabilitation –** Includes furnishing all labor, materials and equipment necessary cleaning and lining of the two (2) existing receiving pits and replacement of existing transfer pump. Contractor shall verify field dimensions of pits and make/model of transfer pump prior to bidding. Pits shall be cleaned and coated in accordance with Section 09961. Once the pits are fully cleaned to the satisfaction of the Engineer, then the contractor shall apply the approved lining system to all surfaces to include side walls, and bottom of the pits. Payment will be made at the contract lump sum price bid and shall include any incidentals necessary to complete the work in accordance with these plans and specifications.

F. **Alternate No. 6 (Additive) – Clarifier Launder Covers –** Includes furnishing all labor, materials and equipment to install clarifier launder covers for existing Clarifiers 1 and 2 currently in operation. Launder covers shall be fiberglass (FRP) weir wall mount configuration designed for algae control by MFG, NEFCO or compatible approved equal. Contractor shall visit the site prior to bidding on the project to confirm dimensions of launder cover systems required. Payment will be made at the contract lump sum price bid and shall include any incidentals necessary to complete the work in accordance with these plans and specifications.

G. **Alternate No. 7 (Additive) – Out of Service Clarifier Rehabilitation –** Includes furnishing all labor, materials and equipment to complete rehabilitation of Clarifier 3. Work shall include, but not be limited to, surface repairs to structure, as necessary, and replacement of equipment including center drive, collector mechanism, skimmer and scum box, assembly hardware, anchor bolts, controls for operation of the clarifier, and all accessories and appurtenances to provide a complete and functioning system. Contractor shall visit the site prior to bidding on the project to confirm dimensions of equipment required. The City will remove existing vegetation and air piping in the clarifier basin prior to Contractor's site visit for inspection. Payment will be made at the contract lump sum price bid and shall include any incidentals necessary to complete the work in accordance with these plans and specifications.

H. **Alternate No. 8 (Additive) – Tractor with Front-End Loader** – Shall reflect the lump sum total to furnish a new tractor with front end loader attachment (2024 John Deere 5075M 4WD Tractor with open station and front-end loader attachment, or compatible approved equal) to provide management of dewatered biosolids at the wastewater treatment plant and land application sites, as needed.

I. **Alternate No. 9 (Additive) – Biosolids Spreader Truck** – Shall reflect the lump sum total to furnish a new biosolids spreader truck (Stahly NL5034G4 Compost**,** or compatible approved equal) to provide management of dewatered biosolids at the wastewater treatment plant and land application sites, as needed.

J. **Alternate No. 10 (Additive) – Water Jetting Trailer** – Shall reflect the lump sum total to furnish a new water jetting trailer (Vactor Ram Jet USJ 4025-750, or compatible approved equal) to provide cleaning of influent sanitary sewer trunk lines to wastewater treatment plant, as needed.

K. The items in the Bid Form are intended to provide full compensation to the Contractor for providing a complete and functional project. Any major items deemed by the proposed bidder to be missing in the Bid Form shall be called to the attention of the Engineer prior to the bid so that an Addendum can be considered. Payment for any minor items necessary to satisfactorily complete the project which are not listed in the Bid Form shall be included in the prices bid for items in the Bid Form. No additional payment will be made for these minor items.

L. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.

M. Coordinate related work and modify surrounding work.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01300

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Coordination and project conditions.

B. Field engineering.

C. Preconstruction meeting.

D. Progress meetings.

E. Pre-installation meetings.

1.2 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.

B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. In finished areas, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

E. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.

F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 FIELD ENGINEERING

A. The Contractor shall employ a Land Surveyor registered in State of Alabama for construction stakeout services. The Engineer can be employed by the Contractor to provide control points if requested.

B. Locate and protect survey control and reference points. Promptly notify Engineer of discrepancies discovered.

C. Control datum for survey is that shown on Drawings.

D. Verify setbacks and easements; confirm drawing dimensions and elevations.

E. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

F. Submit copy of site drawing signed by Land Surveyor certifying elevations and locations of the Work are in conformance with Contract Documents.

G. Maintain complete and accurate log of control and survey work as Work progresses.

H. On completion of foundation walls and major site improvements, prepare certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.

I. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

J. Promptly report to Engineer loss or destruction of reference point or relocation required because of changes in grades or other reasons.

K. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.

1.4 PRECONSTRUCTION MEETING

A. Owner will schedule meeting after Notice of Award.

B. Attendance Required: Owner, Engineer, and Contractor.

C. Agenda:
1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of Subcontractors, list of products, schedule of values, and progress schedule.
5. Designation of personnel representing parties in Contract, and Engineer.
6. Procedures and processing of field decisions, submittals, and substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
7. Scheduling.
8. Scheduling activities of Geotechnical Engineer.

D. Record minutes and distribute copies within five (5) days after meeting to participants, with copies to Engineer, Owner, and those affected by decisions made.

1.5 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.

B. Engineer will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Attendance Required: Job superintendent, major subcontractors and suppliers, Owner, Engineer, as appropriate to agenda topics for each meeting.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems impeding planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

E. Record minutes and distribute copies within five (5) days after meeting to participants, with copies to Engineer, Owner, and those affected by decisions made.

1.6 PRE-INSTALLATION MEETINGS

A. When required in individual specification sections, convene pre-installation meetings at Project site prior to commencing work of specific section.

B. Require attendance of parties directly affecting, or affected by, Work of specific section.

C. Prepare agenda and preside at meeting:
1. Review conditions of installation, preparation and installation procedures.
2. Review coordination with related work.

D. Record minutes and distribute copies within five (5) days after meeting to participants, with copies to Engineer, Owner, and those affected by decisions made.

PART 2 PRODUCTS

Not Used.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittal procedures.

B. Construction progress schedules.

C. Proposed products list.

D. Product data.

E. Shop drawings.

F. Samples.

G. Design data.

H. Test reports.

I. Certificates.

J. Manufacturer's instructions.

K. Manufacturer's field reports.

L. Erection drawings.

M. Construction photography/videography.

1.2 SUBMITTAL PROCEDURES

A. Transmit each submittal with Engineer accepted form.

B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.

C. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

E. Schedule submittals to expedite Project, and deliver to Engineer at business address. Coordinate submission of related items.

F. Provide submittals in both hard copy and electronic media format compatible with Owner and Engineer's viewing software.

G. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.

H. Identify variations from Contract Documents and product or system limitations, which may be detrimental to successful performance of completed Work.

I. Allow space on submittals for Contractor and Engineer review stamps.

J. When revised for resubmission, identify changes made since previous submission.

K. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

L. Submittals not requested will not be recognized or processed.

1.3 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial schedules within 15 days after date established in Notice to Proceed. After review, resubmit required revised data within 10 days.

B. Submit revised Progress Schedules with each Application for Payment.

C. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.

D. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

E. Submit computer generated horizontal bar chart with separate line for each major portion of Work or operation, identifying first work day of each week.

F. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

G. Indicate estimated percentage of completion for each item of Work at each submission.

H. Submit separate schedule of submittal dates for shop drawings, product data, and samples, including Owner furnished products and products identified under Allowances, and dates reviewed submittals will be required from Engineer. Indicate decision dates for selection of finishes.

I. Indicate delivery dates for Owner furnished products and products identified under Allowances.

J. Revisions To Schedules:
   1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.

2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect.

1.4 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.5 PRODUCT DATA

A. Product Data: Submit to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Submit number of copies Contractor requires, plus four copies Engineer will retain.

C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

E. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 01700.

1.6 SHOP DRAWINGS

A. Shop Drawings: Submit to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Submit in form of one reproducible transparency.

D. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 01700.

1.7 SAMPLES

A. Samples: Submit to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Samples For Selection as Specified in Product Sections:
1. Submit to Engineer for aesthetic, color, or finish selection.

2. Submit samples of finishes from full range of manufacturers' standard colors, textures, and patterns for Engineer selection.

C. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

D. Include identification on each sample, with full Project information.

E. Submit number of samples specified in individual specification sections; Engineer will retain one sample.

F. Reviewed samples which may be used in the Work are indicated in individual specification sections.

G. Samples will not be used for testing purposes unless specifically stated in specification section.

H. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01700.

1.8 DESIGN DATA

A. Submit for Engineer's knowledge as contract administrator or for Owner.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.9 TEST REPORTS

A. Submit for Engineer's knowledge as contract administrator or for Owner.

B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.10 CERTIFICATES

A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Engineer, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer.

1.11 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Engineer for delivery to Owner in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.12 MANUFACTURER'S FIELD REPORTS

A. Submit reports for Engineer's benefit as contract administrator or for Owner.

B. Submit report within 30 days of observation to Engineer for information.

C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.13 ERECTION DRAWINGS

A. Submit drawings for Engineer's benefit as contract administrator or for Owner.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

1.14 CONSTRUCTION PHOTOGRAPHY/VIDEOGRAPHY

A. Provide digital photographs and/or video of the site prior to beginning construction and monthly throughout progress of Work.

B. All photo and/or video files shall be saved in a format that is easily read from a Windows-based computer. Each photo/video shall be named or referenced such that their location within the project area is easily identifiable. Additional information provided shall include name of Project, project number, orientation of view, and date and time of view.

C. All files shall be submitted via a thumb drive, a portable hard drive, or an approved cloud-based file storage transfer.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01400

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality control and control of installation.

B. Tolerances

C. References.

D. Mock-up requirements.

E. Testing and inspection services.

F. Manufacturers' field services.

G. Examination.

H. Preparation.

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

A. For products or workmanship specified by association, trades, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.5 MOCK-UP REQUIREMENTS

A. Tests will be performed under provisions identified in this section and identified in respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be comparison standard for remaining Work.

D. Where mock-up has been accepted by Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Engineer.

1.6 TESTING AND INSPECTION SERVICES

A. Employ and pay for services of an independent testing agency or laboratory acceptable to Owner to perform specified testing.
   1. Three Notch Group can perform the required material testing and geotechnical evaluation for this project.
   2. Prior to start of Work, submit testing laboratory name, address, and telephone number if Three Notch Group is not selected.

3. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of deficiencies reported by inspection.

B. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Engineer.
   1. Laboratory: Authorized to operate in State of Alabama
   2. Laboratory Staff: Maintain full time registered Engineer on staff to review services.
   3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.

C. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Engineer or Owner.

D. Reports will be submitted by independent firm to Engineer and Contractor, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Engineer and independent firm 24 hours prior to expected time for operations requiring services.
   2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

F. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

G. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Price.

H. Agency Responsibilities:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
   6. Perform additional tests required by Engineer.
   7. Attend preconstruction meetings and progress meetings.

I. Agency Reports: After each test, promptly submit two copies of report to Engineer and to Contractor. When requested by Engineer, provide interpretation of test results. Include the following:
   1. Date issued.
   2. Project title and number.
   3. Name of inspector.
   4. Date and time of sampling or inspection.
   5. Identification of product and specifications section.
   6. Location in Project.
   7. Type of inspection or test.
   8. Date of test.
   9. Results of tests.
   10. Conformance with Contract Documents.

J. Limits On Testing Authority:
   1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency or laboratory may not approve or accept any portion of the Work.
   3. Agency or laboratory may not assume duties of Contractor.
   4. Agency or laboratory has no authority to stop the Work.

1.7 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and training as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Engineer 30 days in advance of required observations.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

D. Refer to Section 01330 - SUBMITTAL PROCEDURES, MANUFACTURERS' FIELD REPORTS article.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products.

B. Product delivery requirements.

C. Product storage and handling requirements.

D. Product options.

E. Product substitution procedures.

1.2 PRODUCTS

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

C. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products in accordance with manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

D. For exterior storage of fabricated products, place on sloped supports above ground.

E. Provide off-site storage and protection when site does not permit on-site storage or protection.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.

H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.6 PRODUCT SUBSTITUTION PROCEDURES

A. Engineer will consider requests for Substitutions only within 30 days after date established in Notice to Award and no sooner than 10 days prior to the Notice to Proceed date.

B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that Contractor:
   1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
   2. Will provide same warranty for Substitution as for specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.
   5. Will reimburse Owner and Engineer for review or redesign services associated with re-approval by authorities having jurisdiction.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.

F. Substitution Submittal Procedure:
   1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
   2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
   3. Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01700

EXECUTION REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Closeout procedures.

B. Final cleaning.

C. Starting of systems.

D. Demonstration and instructions.

E. Testing, adjusting and balancing.

F. Protecting installed construction.

G. Project record documents.

H. Operation and maintenance data.

I. Manual for materials and finishes.

J. Manual for equipment and systems.

K. Spare parts and maintenance products.

L. Product warranties and product bonds.

M. Maintenance service.

1.2 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's review.

B. Provide submittals to Engineer required by authorities having jurisdiction.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.3 FINAL CLEANING **(If Applicable)**

A. Execute final cleaning prior to final project assessment.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.

D. Replace filters of operating equipment.

E. Clean debris from roofs, gutters, downspouts, and drainage systems.

F. Clean site; sweep paved areas, rake clean landscaped surfaces.

G. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.4 STARTING OF SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Engineer seven days prior to start-up of each item.

C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable manufacturer's representative in accordance with manufacturers' instructions.

G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report in accordance with Section 01330 that equipment or system has been properly installed and is functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.

B. Demonstrate Project equipment and instructed by qualified manufacturer's representative who is knowledgeable about the Project.

C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.

F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

G. Required instruction time for each item of equipment and system is specified in individual sections.

1.6 TESTING, ADJUSTING AND BALANCING

A. Owner will appoint and employ services of independent firm to perform testing, adjusting, and balancing.

B. Reports will be submitted by independent firm to Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

1.7 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

1.8 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed Shop Drawings, Product Data, and Samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Drawings : Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

G. Submit documents to Engineer with claim for final Application for Payment.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit data bound in 8-1/2 x 11 inch (A4) text pages, capacity expansion binders with durable plastic covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.

C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

E. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and maintenance instructions arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Operating instructions.
      e. Maintenance instructions for equipment and systems.
      f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
   3. Part 3: Project documents and certificates, including the following:
      a. Shop drawings and product data.
      b. Air and water balance reports.
      c. Certificates.
      d. Originals of warranties.

1.10 MANUAL FOR MATERIALS AND FINISHES

A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned after final inspection, with Engineer comments. Revise content of document sets as required prior to final submission.

D. Submit two sets of revised final volumes in final form within 10 days after final inspection.

E. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Include information for re-ordering custom manufactured products.

F. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

G. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.

H. Additional Requirements: As specified in individual product specification sections.

I. Include listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.11 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned after final inspection, with Engineer comments. Revise content of document sets as required prior to final submission.

D. Submit two sets of revised final volumes in final form within 10 days after final inspection.

E. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

F. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; by label machine.

G. Include color coded wiring diagrams as installed.

H. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and special operating instructions.

I. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

J. Include servicing and lubrication schedule, and list of lubricants required.

K. Include manufacturer's printed operation and maintenance instructions.

L. Include sequence of operation by controls manufacturer.

M. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

N. Include control diagrams by controls manufacturer as installed.

O. Include Contractor's coordination drawings, with color coded piping diagrams as installed.

P. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

Q. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

R. Include test and balancing reports as specified in Section 01400.

S. Additional Requirements: As specified in individual product specification sections.

T. Include listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

1.12 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.

B. Deliver to Project site and place in location as directed by Owner; obtain receipt prior to final payment.

1.13 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.

B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Include Table of Contents and assemble in binder with durable plastic cover.

F. Submit prior to final Application for Payment.

G. Time Of Submittals:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
   2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.

3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.14 MAINTENANCE SERVICE

A. Furnish service and maintenance of components indicated in specification sections during warranty period.

B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.

D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 02050

MOBILIZATION

DESCRIPTION: Covers the preparatory Work and operations including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to and from the project site; for the establishment of all offices, buildings, and other facilities necessary for work on the project; and for all other Work and operations which must be performed or costs incurred prior to beginning work on the various items on the project site.

UNIT PRICE - MEASUREMENT AND PAYMENT

A. Basis of Measurement: Lump Sum.

B. Basis of Payment: Partial payments for mobilization are allowed based on the amount bid for mobilization and the total original contract amount for all items of work. Payment will be made at the time, and in the amounts shown in the following schedules.

SCHEDULE OF PARTIAL PAYMENTS FOR MOBILIZATION WHEN BID PRICE FOR MOBILIZATION IS 10% OR LESS OF ORIGINAL CONTRACT AMOUNT (Partial Payments are a % of the Contract Amount for Mobilization)		
TIME OF PAYMENT	AMOUNT OF PAYMENT	ACCUMULATED PAYMENT
At the First Estimate and Upon Completion of 5% of the Original Contract Amount	70% of the Bid Price for Mobilization	70% of the Bid Price for Mobilization
After the First Estimate and Upon Completion of 50% of the Original Contract Amount Including Prior Payment for Mobilization	25% of the Bid Price for Mobilization	95% of the Bid Price for Mobilization
Upon Completion and Readiness for Final Payment.	5% of the Bid Price for Mobilization	100% of the Bid Price for Mobilization

SCHEDULE OF PARTIAL PAYMENTS FOR MOBILIZATION WHEN BID PRICE FOR MOBILIZATION IS GREATER THAN 10% OF ORIGINAL CONTRACT AMOUNT (Partial Payments are a % of the Contract Amount, Except the Final Payment)		
TIME OF PAYMENT	AMOUNT OF PAYMENT	ACCUMULATED PAYMENT
At the First Estimate and Upon Completion of 5% of the Original Contract Amount	6% of the Original Contract Amount	6% of the Total Contract Amount
After the First Estimate and Upon Completion of 50% of the Original Contract Amount Including Prior Payment for Mobilization	4% of the Original Contract Amount	10% of the Total Contract Amount
Final Estimate	Remainder of Contract Amount for Mobilization	100% of Contract Amount for Mobilization

END OF SECTION

SECTION 02060

AGGREGATE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Coarse aggregate materials.
2. Fine aggregate materials.

B. Related Sections:
1. Plans and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
5. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Basis of Measurement: Cubic yard or as indicated in the Plans and/or Bid Form

B. Basis of Payment: Includes all labor, materials and equipment for the installation of aggregate including hauling, placing, spreading, grading to the proper level, cleanup and all related items.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Samples: Submit 10-gallon sample of each type of aggregate to testing laboratory.

C. Materials Source: Submit name of imported materials suppliers.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

PART 2 PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

A. Coarse aggregate shall consist of crushed gravel or stone having hard, strong, durable pieces, free from adherent coatings.

B. Coarse Aggregate Type A1 (ALDOT Aggregate size No. 4) shall be graded in accordance with the following limits:

Sieve Size	Percent Passing
2 inches	100
1-1/2 inch	90 to 100
1 inch	20 to 55
3/4 inch	0 to 15
1/2 inch	-----
3/8 inch	0 to 5
No. 4	-----
No. 8	-----
No. 16	-----
No. 50	-----
No. 200	-----

C. Coarse Aggregate Type A2 (ALDOT Aggregate size No. 57) shall be graded in accordance with the following limits:

Sieve Size	Percent Passing
2 inches	-----
1-1/2 inch	100
1 inch	95 to 100
3/4 inch	-----
1/2 inch	25 to 60
3/8 inch	-----
No. 4	0 to 10
No. 8	0 to 5
No. 16	-----
No. 50	-----
No. 200	-----

D. Coarse Aggregate Type A3 (ALDOT Aggregate size No. 78) shall be graded in accordance with the following limits:

Sieve Size	Percent Passing
2 inches	-----
1-1/2 inch	-----
1 inch	-----
3/4 inch	100
1/2 inch	90 to 100
3/8 inch	40 to 75
No. 4	5 to 25
No. 8	0 to 10
No. 16	0 to 5

2.2 FINE AGGREGATE MATERIALS

A. Fine Aggregate Type A4 (Concrete Sand): Washed sand; free of loam, friable or soluble materials, and organic matter; non-plastic; graded in accordance with ASTM C136; within the following limits:

Sieve Size	Percent Passing
3/8 inch	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 90
No. 50	5 to 30
No. 100	0 to 10

B. Fine Aggregate Type A5 (Natural Sand): Natural sand; free of loam, friable or soluble materials, and organic matter; non-plastic; graded in accordance with ASTM C136; within the following limits:

Sieve Size	Percent Passing
3/8 inch	100
No. 4	95 to 100
No. 8	----
No. 16	50 to 80
No. 50	20 to 50
No. 100	10 to 25
No. 200	5 to 12

2.3 SOURCE QUALITY CONTROL

A. Section 01400 - Quality Requirements.

B. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with ASTM D698, ASTM D1557, ASTM D4318, or ASTM C136.

C. Fine Aggregate Material - Testing and Analysis: Perform in accordance with ASTM D698, ASTM D1557, ASTM D4318, or ASTM C136.

D. When tests indicate materials do not meet specified requirements, change material and retest.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavate aggregate materials from on-site locations as specified in Section 02300.

B. Stockpile excavated material meeting requirements for coarse aggregate materials and fine aggregate materials.

C. Remove excess excavated materials not intended for reuse, from site.

D. Remove excavated materials not meeting requirements for coarse aggregate materials and fine aggregate materials from site.

3.2 STOCKPILING

A. Stockpile materials on site.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.

D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

E. Stockpile unsuitable materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 02085

VALVES FOR WATER AND SEWER SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Tapping Sleeve and Valves
2. Rubber Seated Butterfly Valves
3. Resilient Wedge Gate Valves
4. Eccentric Plug Valves
5. Swing Check Valves
6. Silent Check Valves
7. Insertion Valves
8. Air/Vacuum and Air Release Valves (Including Combination Types)
9. Pilot Operated Control Valves
10. Line Stopping
11. Accessories

B. Related Sections:
1. Plans and general provisions of the Contract including General Conditions, Special Provisions and Technical Specifications.

1.2 REFERENCES

A. American Water Works Association:

1. AWWA C111 / A21.11-17 – Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
2. AWWA C115 - ANSI Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
3. AWWA C116 – Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray-Iron Fittings
4. AWWA C504 – Rubber-Seated Butterfly Valves
5. AWWA C508 – Swing Check Valves for Waterworks Service 2 in through 48 in
6. AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service
7. AWWA C512 – Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service.
8. AWWA C515 – Reduced Wall, Resilient-Seated Gate Valves for Water-Supply Service.
9. AWWA C517 – Resilient-Seated Cast Iron Eccentric Plug Valves
10. AWWA C530 – Pilot-Operated Control Valves
11. AWWA C541 – Hydraulic and Pneumatic Cylinder and Vane Type Actuators for Valves and Slide Gates
12. AWWA C542 – Electric Motor Actuators for Valves and Slide Gates
13. AWWA C550 - Protecting Epoxy Interior Coating for Valves and Hydrants.

14. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

B. National Sanitation Foundation:
   1. NSF 61 - Drinking Water System Components - Health Effects

1.3 UNIT PRICE – MEASUREMENT AND PAYMENT

A. Tapping Sleeve and Valve Assemblies:
   1. Basis of Measurement: Each, unless otherwise noted in the Plans.
   2. Basis of Payment: Includes all labor, material, and equipment associated with excavation (includes rock excavation), installation of tapping sleeve and tapping valve, tap of existing line, removal of coupon, installation of associated valve riser (valve box), concrete ring around top of valve box, valve marker, general fill, testing, cleanup and restoration, and all related items.

B. Insertion Valves:
   1. Basis of Measurement: Each, unless otherwise noted in the Plans.
   2. Basis of Payment: Includes all labor, material, and equipment associated with excavation (includes rock excavation), preparation of pipe at insertion site, and installation of the insertion valve assembly in accordance with the manufacturer's recommendations. Also includes installation of associated valve riser (valve box), concrete ring around top of valve box, valve marker, general fill, testing, cleanup and restoration, and all related items.

C. Water and Sewer Valves:
   1. Basis of Measurement: Each, unless otherwise noted in the Plans or if a portion of an assembly.
   2. Basis of Payment: Includes all labor, material, and equipment associated with excavation (including rock excavation), connection and placement of valve, joint restraints, installation of associated valve riser (valve box), concrete ring around top of valve box, valve marker, general fill, compaction, cleanup and restoration, testing, and all related items.

D. Pilot Operated Control Valve Assemblies:
   1. Basis of Measurement: Per Each or Lump Sum as indicated in the Proposal.
   2. Basis of Payment: Includes all labor, material, and equipment associated with excavation (including rock excavation), valve vault, pilot operated control valve, associated internal and external piping as indicated in the plans, associated isolation valves as indicated in the Plans, drain piping as indicated in the Plans, related site work, general fill, compaction, cleanup and restoration, testing, start-up and commissioning services, and all related items.

E. Air Release and Air/Vacuum Valve Assemblies:
   1. Basis of Measurement: Each, unless otherwise noted in the Plans or if a portion of an assembly
   2. Basis of Payment: Includes all labor, material, and equipment associated with excavation (including rock excavation), vault or manhole for access, air valve assembly, connection to main, connecting internal piping, isolation valves and

valves associated with accessories, drain piping as indicated in the Plans, fill as indicated in the plans, compaction ,cleanup and restoration, testing, and all related items.

F. Line Stopping Assemblies:
   1. Basis of Measurement: Each, unless otherwise noted in the Plans or if a portion of an assembly
   2. Basis of Payment: Includes all labor, material, and equipment associated with excavation (including rock excavation), preparation of pipe at the location to be stopped off, and the installation of a temporary line stopping assembly in accordance with the manufacturer's recommendations. Also includes a concrete line stop support (with pipe wrapped with visqueen or polywrap) according to the manufacturer's requirements, but with minimum dimensions of 2 feet from both ends and sides of the assembly and a depth from the spring line to 2 feet below the main.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Shop Drawing:
   1. Installation Plan: Submit description of proposed installation.

C. Design Data: Submit manufacturer's latest published literature include illustrations, installation instructions, maintenance instructions and parts lists.

D. Manufacturer's Certificates: Submit Statement of Compliance and supporting data, from material suppliers stating that equipment and accessories provided meet or exceed AWWA Standards, NSF 61 certification, and specification requirements.

E. For Pilot-Operated Control Valves, provide schematic for pilot system operation.

F. For Insertion Valves or Line Stopping Assemblies, provide proposed procedures.

1.5 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements.

B. Project Record Documents: Record actual locations of valves and appurtenances.

C. Provide Operation and Maintenance Data for equipment indicating materials of construction, recommended maintenance activities and intervals, procedures for adjustments and troubleshooting, and sources for procurement of replacement parts.

D. For Pilot-Operated Control Valves, provide certification from manufacturer certifying installation of equipment in accordance with manufacturer's recommendations.

E. Where the Plans or Special Provisions require such, provide spare parts and maintenance materials to Owner.

1.6 QUALITY ASSURANCE

A. All Products for use in potable water systems shall be NSF 61 certified.

1.7 QUALIFICATIONS

A. Manufacturer:
   1. Utilize equipment and materials from Owner's standard list of acceptable manufacturers provided in the Special Provisions. If no such list is provided, utilize equipment and materials from list of acceptable manufacturers provided in these specifications.
   2. Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE AND HANDLING

A. Section 01600 - Product Requirements.

B. Prepare valves and accessories for shipment according to AWWA Standards and seal valve ends to prevent entry of foreign matter into product body.

C. Store products in accordance with manufacturer's written recommendations and instructions, and in areas protected from weather, moisture, or possible damage; do not store products directly on ground.

D. Handle products in accordance with manufacturer's written recommendations and instructions, and in such a manner as to prevent damage to interior or exterior mechanisms and surfaces.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01600 - Product Requirements.

B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

PART 2 PRODUCTS

2.1 BASIC PROVISIONS FOR GATE, PLUG, BUTTERFLY, AND CHECK VALVES

A. End Connections: Mechanical joint, flanged, or wafer type as indicated in the Plans. If no such indication is provided, utilize mechanical joint for buried applications and flanged joints for exposed applications. Mechanical joints shall conform to AWWA C111 and shall be provided with retainer gland devices. Flanged joints shall conform to AWWA C115

ANSI B16.1 CL 150 unless noted otherwise and shall be provided with 316 stainless steel nuts and bolts.

B. Valve operators:
   1. Provide gate, plug, and butterfly valves with open-left (counterclockwise) operation.
   2. Provide gate valves with non-rising stems unless specifically stated otherwise in the plans.
   3. Provide with 2-inch square operating nut for buried applications
   4. Provide with handwheel operator for exposed applications with manual opening, or 2-inch square operating nut where electric or pneumatic actuator is utilized.
   5. Provide side-mounted right-angle gear reducer on plug and butterfly valves 6-inch and larger, and on gate valves 16 inch and larger.

C. Coatings:
   1. Provide fusion-bonded epoxy coating conforming to AWWA C116 on all valves for buried applications.
   2. Provide coating in accordance with specification Section 09900 on all valves for exposed applications where this section is included. If section is not included provide bituminous coating.

D. Provide flow direction arrow on all plug and check valves.

2.2 TAPPING SLEEVES AND VALVES

A. Tapping Sleeves:
   1. Stainless steel, full circumferential gasket, flanged outlet.
   2. Manufacturers:
      a. Mueller.
      b. JCM Industries
      c. Ford Meter Box Co.
      d. Substitutions: Section 01600 - Product Requirements.
   3. Outlet Flange Dimensions and Drilling: AWWA C207 Class D, ANSI 150lb. drilling and MSS SP-60.

B. Tapping Valves:
   1. AWWA C515, resilient wedge with non-rising stem. Epoxy coated ductile iron body. Inlet flanges shall conform to ANSI B16.1, Class 150 and MSS SP-60. Mechanical joint outlets shall conform to AWWA C111.
   2. Manufacturers:
      a. Mueller
      b. M and H
      c. American Flow Control
      d. Substitutions: Section 01600 - Product Requirements.

2.3 RUBBER SEATED BUTTERFLY VALVES

A. Manufacturers:
   1. Dezurik
   2. Pratt
   3. Valmatic
   4. Substitutions: Section 01600 – Product Requirements

B. Valve body and disc constructed of ASTM A 536 cast iron (Grade 65-45-12). Valve disc shall be of the solid type.

C. Valve shaft constructed of ASTM A 276 Type 304 stainless steel.

D. Resilient seat constructed of Buna-N mated to Type 316 stainless steel body seat ring. Resilient seat shall be located on the valve disc and shall provide a continuous, uninterrupted seating surface.

E. All retaining hardware constructed of Type 316 stainless steel.

F. 150 psi maximum working pressure rating unless stated otherwise in the plans.

2.4 RESILIENT WEDGE GATE VALVES

A. Manufacturers:
   1. Mueller
   2. M and H Valve Co.
   3. American Flow Control
   4. Substitutions: Section 01600 - Product Requirements.

B. Resilient Wedge Gate Valves: AWWA C515; ductile iron wedge and body.
   1. Resilient seats.
   2. Stem: Non-rising bronze stem.
   3. Wedge: Ductile iron, completely encapsulated with resilient material.
   4. All internal parts shall be accessible without removing the body from the line.
   5. 250 psig maximum working pressure rating standard or 350 psi maximum working pressure rating where indicated on the plans.

2.5 ECCENTRIC PLUG VALVES

A. Manufacturers:
   1. DeZurik
   2. Mueller
   3. Pratt
   4. Substitutions: Section 01600 – Product Requirements

B. Solid, one-piece plug constructed of cast iron conforming to ASTM A 126 Class B or ductile iron conforming to ASTM 536 Grade 65-45-12.

C. Cast iron body conforming to ASTM A 126 Class B with rectangular port. Permanently lubricated sleeve-type bearings constructed of Type 316 stainless steel.

D. Maximum working pressure rating of at least 175 psi for 12-inch and smaller valves, at least 150 psi for larger valves.

2.6 SWING CHECK VALVES

A. Manufacturers:
   1. Dezurik
   2. M and H Valve
   3. Mueller
   4. Pratt
   5. Substitutions: Section 01600 – Product Requirements.

B. Body, disc, and disc arm constructed of ASTM A 536 ductile iron (65-45-12).

C. Shaft shall be a single piece, constructed of Type 304 stainless steel.

D. Valve to be of single disc type with full flow passage.

E. Valve supplied with lever and weight unless plans require oil or air cushioning device.

F. Valve to have bolted removable cover for cleaning and maintenance.

G. 200 psi maximum working pressure rating for 3-inch through 12-inch valves, 150 psi for valves larger than 12-inch, unless noted otherwise in the plans.

2.7 SILENT CHECK VALVES

A. Manufacturers:
   1. Dezurik
   2. Pratt
   3. Val-Matic
   4. Substitutions: Section 01600 – Product Requirements

B. Valve body constructed of ASTM A536 ductile iron (65-45-12).

C. Valve to incorporate a center guided, spring loaded disc, guided at opposite ends and having a short linear stroke that generates a flow area equal to pipe size.

D. Seat and disc to be cast bronze or aluminum bronze. Compression spring to be Type 316 stainless steel.

E. Valve to have a replaceable guide bushing held in position by the spring. The spring shall be designed to withstand 100,000 cycles without failure and provide a cracking pressure of 0.5 psi.

F. Valve disc to be concave to the flow direction.

G. Leakage rate not to exceed one-half the allowable rate for metal seated valves under AWWA C508 or 0.5 oz per hour per inch of valve diameter.

H. 250 psi maximum working pressure rating unless noted otherwise in the plans.

2.8 INSERTION VALVES

A. Manufacturers:
1. TEAM Industrial Services
2. Advanced Valve Technologies
3. Hydra-Stop
4. Substitutions: Section 01600 – Product Requirements

B. Valve body constructed of ASTM A536 ductile iron (65-45-12).

C. Hardware: 304 Stainless Steel

D. Seat and disc to be cast bronze or aluminum bronze. Compression spring to be Type 316 stainless steel.

E. Valve to have a replaceable guide bushing held in position by the spring. The spring shall be designed to withstand 100,000 cycles without failure and provide a cracking pressure of 0.5 psi.

F. Leakage rate not to exceed one-half the allowable rate for metal seated valves under AWWA C508 or 0.5 oz per hour per inch of valve diameter.

G. 250 psi maximum working pressure rating unless noted otherwise in the plans.

2.9 AIR/VACUUM AND AIR RELEASE VALVES

A. Manufacturers:
1. ARI, Inc
2. APCO Valve and Primer Company
3. Crispin Valve
4. Valmatic Valve Co.
5. Substitutions: Section 01600 - Product Requirements.

B. Air release and air/vacuum valves shall be specifically designed by the manufacturer for either clean water service (in the case of finished potable water or other non-solids bearing water systems) or sewage service (in the case of sewerage or other potentially solids bearing systems such as raw water service) as indicated in the plans.

C. Provide air/vacuum valves, air release valves, or combination air valves having the following functionality as indicated in the plans.
1. Air/Vacuum Valves shall open to exhaust large volumes of air in situations such as pipeline filling and shall also open to admit air for the purpose of relieving internal vacuum conditions in situations such as pipeline draining.

2. Air Release Valves shall open to exhaust small pockets of air while the pipeline is operating under pressure.
3. Combination Air Valves shall have the functionality of both air/vacuum valves and air release valves and may be of either the single body or dual body configured.

D. Design Requirements:
1. Provide Air Release and Combination Air Valves with minimum 5/16-inch orifice for exhausting small pockets of air while pipeline is operating under pressure.
2. Provide all air valves and all related accessories with pressure ratings equal to or greater than the maximum pipeline working pressure at the location of the air valve installation.
3. Provide all air valves with low pressure sealing capability equal to or less than 2 psi or, where specifically indicated in the plans, equal to or less than 1 psi.

E. End Connections:
1. 2-inch and smaller valves: Threaded end connections
2. Valves larger than 2-inch: Flanged end connections conforming to ANSI B 16.1 CL 125 unless otherwise indicated in the plans.

F. Accessories:
1. Provide the following accessories with each assembly:
   a. For clean water service applications:
      1) Provide inflow preventing device which prevents entry of external water into the pipeline system through the air inlet / outlet. Device shall allow the entry or exit of air while preventing entry of water.
      2) Provide shut-off valve on the inlet side of the valve which allows isolation of the air valve from the pipeline system. Valve shall have the same or greater pressure rating as the pipeline system.
         a) Utilize bronze ball valves with end connections compatible with air valve inlet connection for 2-inch and smaller air valves.
         b) Utilize gate valve with end connections compatible with air valve inlet connection for air valves larger than 2 inches.
   b. For sewage service applications:
      1) Provide backflushing accessories as follows:
         a) Blow-off / drain connection and shut-off valve.
         b) Clean water supply connection and shut-off valve.
         c) Backwash supply hose with quick disconnect.
         d) All shut-off valves shall be bronze, full-ported ball valves.
      2) Provide shut-off valve on the inlet side of the valve which allows isolation of the air valve from the pipeline system. Valve shall have the same or greater pressure rating as the pipeline system.
         a) Utilize bronze ball valves with end connections compatible with air valve inlet connection for 2-inch and smaller air valves.
         b) Utilize gate valve with end connections compatible with air valve inlet connection for air valves larger than 2 inches.

2.10 PILOT OPERATED CONTROL VALVES

A. Manufacturers:
   1. Bermad
   2. Cla-Val
   3. Watts
   4. Substitutions: Section 01600 - Product Requirements

B. Globe or angle pattern as indicated in the plans with ductile iron body and cover conforming to ASTM A 536. Provide with NSF 61 listed fusion bonded epoxy coating and interior lining. Studs and cover nuts shall be 316 stainless steel.

C. Stainless steel throttling components.

D. All trim shall be stainless steel.

E. Disc and diaphragm assembly shall contain a BUNA-N synthetic rubber seal securely retained on 3-1/2 sides by a disc retainer and disc guide.

F. End Connections:
   1. For main valves larger than 2-inch, provide flanged end connections conforming to ASTM C115 ANSI B16.1 CL 125 unless otherwise indicated in the plans.
   2. For main valves 2-inch and smaller, threaded end connections may be utilized if approved by the Engineer.

G. Pilot system:
   1. Regulators, fittings, and valves shall be constructed of stainless steel. Pilot system tubing shall be constructed of braided, flexible stainless steel tubing. All components of the pilot system shall have a working pressure rating in excess of the anticipated pressure conditions shown on the plans.
   2. Operation range suitable for the pressure range indicated in the plans.
   3. Provide with an external Y-strainer, adjustable opening and closing speed components, and ball-type isolation cock valves.
   4. All wetted surfaces contacted by consumable water shall contain less than 0.25% lead by weight.
   5. Pilot system manufactured and assembled by the same company as the main valve.

H. Accessories:
   1. Provide brass or stainless steel engraved nameplate for each control valve and associated pilot securely affixed to the associated component. Nameplate shall indicate the following information as applicable:
      a. Catalog and serial number
      b. Function, size, material, and pressure rating
      c. Type of pilot control system used and control adjustment range
   2. Where indicated in the plans, provide valve position indicating post.
   3. Where indicated in the plans, provide pressure gauges as follows:
      a. 4-inch diameter, glycerin-filled stainless steel with the pressure measurement range as indicated in the plans.

b. Provide with threaded connections and stainless steel connecting tubing and fittings.
c. Minimum of ½" diameter tap size or larger where indicated in the plans.
d. Provide with quarter-turn ball shut-off valves.
e. Provide with pulsation damper where indicated in the plans.

4. Where indicated in the plans, provide main-line strainer:
   a. Provide the same size as the control valve and installed immediately upstream from the control valve.
   b. Ductile iron body with epoxy coating matching that of the control valve body.
   c. Flanged end connections sized to match those of the associated control valve.
   d. Incorporate stainless steel screen which is removable for replacement or maintenance without removing the strainer body.
   e. NSF-61 certified.
   f. Assembly rated for the same working pressure as the control valve.
5. Where indicated in the plans, provide accessories, trim, and configuration which reduces internal cavitation.
6. Where required for valve function, provide solenoids suitable for operation on 120V single-phase AC power, with NEMA IV enclosure and manual operator unless indicated otherwise in the plans.

I. Control Valve Operations and Functionality:
1. Control valves of the following types shall function through a pilot control system as follows:
   a. Pressure Reducing Valves – Automatically reduce a varying upstream pressure to an operator-adjustable constant downstream pressure set point, regardless of flow rate. A decrease in downstream pressure shall cause the main valve to increase its opening, thereby increasing the downstream pressure toward the set point. An increase in downstream pressure shall cause the main valve to decrease its opening, thereby decreasing the downstream pressure toward the set point. Where specifically indicated in the plans, provide an internal check feature which prevents flow from downstream to upstream via the pilot control system.
   b. Pressure Relief Valves – Remain closed while upstream pressure is below an operator-adjustable set point. Open to exhaust water and relieve pressure when upstream pressure exceeds the set point.
   c. Surge Anticipator Valves – Automatically open a pre-set amount upon upstream pressure falling below an operator adjustable set point in anticipation of oncoming surge. Automatically close upon pressure rising above set point.
   d. Pressure Sustaining Valves – Automatically maintain upstream pressure at an operator-adjustable set point with varying downstream pressure, regardless of flow rate. A decrease in upstream pressure shall cause the main valve to decrease its opening, thereby decreasing the flow rate and increasing upstream pressure toward the set point. An increase in upstream pressure shall cause the main valve to increase its opening, thereby increasing the flow rate and decreasing the upstream pressure toward the set point.

e. Single Acting Altitude Valves – Remain fully open until the water level in a downstream reservoir or tank reaches an operator-adjustable level setpoint, then close fully. Upon the water level in the downstream tank or reservoir falling a pre-set distance, re-open fully. This valve shall be designed for one-way flow only.

f. Double Acting Altitude Valve – Remain fully open until the water level in a downstream reservoir or tank reaches an operator-adjustable level set point, then close fully. Upon either pressure on the upstream side falling below an operator-adjustable set point, or, the water level in the downstream reservoir or tank falling a pre-set distance, re-open fully. This valve shall be designed for two-way flow.

g. Solenoid-Controlled Open / Close Valve – Either open or close pilot system in response to a changing electrical current to the solenoid, which in turn either opens or closes the main valve. Solenoid shall be either normally open (open upon loss of electrical signal) or normally closed (close upon loss of electrical signal) as indicated in the plans.

h. Solenoid-Controlled Booster Pump Control Valve – Pump operation shall begin with the control valve closed. Upon pump start-up, simultaneously energize solenoid and begin opening the main valve slowly, as controlled by the opening speed control. Upon signal to shut-down pump, maintain the pump running, de-energize the solenoid, and begin slowly closing the main valve, as controlled by the closing speed control. Upon main valve reaching the fully-closed position, a limit switch shall release a valve / pump interlock, and the pump shall shut down. Where indicated in the plans an internal check feature shall be provided to prevent reverse flow.

i. Solenoid-Controlled Deep Well Pump Control Valve – Pump operation shall begin with the valve open. Upon pump start-up, simultaneously energize solenoid and begin closing the main valve slowly, as controlled by the closing pump speed control. Upon signal to shut down the pump or upon loss of power, the solenoid is de-energized, and the main valve begins to open slowly, as controlled by the opening speed control. Upon the main valve reaching the fully open position,

2.11 LINE STOPPING ASSEMBLIES

A. Manufacturers:
   1. JCM Industries
   2. Substitutions: Section 01600 – Product Requirements

B. Blind Flange: 150 lb, ASTM A36 Carbon Steel, Epoxy Coated

C. Blind Flange Gasket: Styrene-Butadiene Rubber (SBR) compounded for use with water

D. Gasket: Nitrile Butadiene Rubber (NBR, Buna-N) per ASTM D2000

E. Bolts and Hardware: Stainless Steel 18-8 Type 304

F. Finish: Fusion applied Epoxy Coating per ANSI/AWWA C213 Standard

2.12 ACCESSORIES

A. Valve Boxes for Buried Valves:
   1. 12-inch diameter valves and smaller: Domestic cast iron, two-piece, screw type for height adjustment.
   2. Valves larger than 12-inch: Domestic cast iron, three-piece, screw type for height adjustment.
   3. For either size condition, provide 6-inch ductile iron pipe riser sections as required for additional height where standard is insufficient.
   4. Provide with cast iron lid marked "Water" or "Sewer" as applicable

B. Valve Markers for Buried Valves:
   1. Provide fiberglass marker (either round or flat) or concrete monument as required in the plans. If no such indication is present, provide flat fiberglass marker.
   2. For fiberglass markers, provide either blue color for potable water or green color for sewer. Provide with Owner's standard labeling information as indicated in the plans or specifications. If no such information is present, provide minimum labeling as follows:
      a. "Warning – Water (Sewer) Pipeline Below"
      b. Notification to contact 811 service before digging
      c. Owner's emergency contact information.
   3. For concrete markers, provide dimensions as indicated in the plans. Provide with markings as shown in the plans. If no such information is present, provide minimum information as follows:
      a. "Water (Sewer) Valve

C. Valve Operating Nut Stem Extensions:
   1. For buried valves where the valve operating nut is greater than 48-inches below the top of the valve box, provide a stainless steel stem extension designed to fit snugly and securely onto operating nut and with 2-inch square top operating nut designed to fit into standard valve wrench. Provide length as required so that top of operating nut is between 12 and 36 inches below the top of the valve box.
   2. For non-buried valves, provide stainless steel stem extensions and appropriate mounting brackets / guides where indicated in the plans. For applications where electric or pneumatic actuators are utilized, extensions shall be suitably sized to withstand torque imparted by actuator.

D. Post Type Position Indicators:
   1. Manufacturers:
      a. Mueller
      b. M and H Valve
      c. American Flow Control
      d. Substitutions: Section 01600 - Product Requirements.
   2. Vertical Indicator Post designed to operate a non-rising stem gate valve with above ground visual indication of valve position (open or shut).
   3. Indicator post shall feature a telescoping stem that can be adjusted to its final position without field cutting of the stem.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Determine exact location, configuration, features, and size of valves and accessories from the Plans; obtain clarification and directions from Engineer prior to execution of work.

C. Verify invert elevations of existing work prior to excavation and installation.

3.2 PREPARATION

A. Identify required lines, levels, contours and datum locations.

B. Locate, identify, and protect utilities to remain from damage.

C. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.

3.3 INSTALLATION

A. Install all equipment in accordance with manufacturer's instructions.

3.4 EQUIPMENT START-UP AND COMMISSIONING

A. For pilot-operated control valves, provide on-site services of a manufacturer-certified start-up technician to initially establish set points prior to start-up and make adjustments to equipment as necessary following initial start-up. Start-up technician shall instruct Owner's staff on operation, maintenance and adjustments of equipment. Services shall be provided for a minimum of 8 hours on-site per control valve, and additionally as necessary if there are difficulties associated with the start-up, at no additional cost to the Owner.

3.5 DISINFECTION OF POTABLE WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 02516.

END OF SECTION

SECTION 02225

MINOR DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Demolishing designated building equipment and fixtures.
2. Demolishing designated construction.
3. Cutting and alterations for completion of the Work.
4. Removing designated items for Owner's retention.
5. Protecting items designated to remain.
6. Removing demolished materials.

B. Related Sections:
1. Drawings and general provisions of the Contract including General and Supplementary Conditions, Special Conditions, Technical Specifications, and General Requirements.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

A. Basis of Measurement: Lump Sum.

B. Basis of Payment: Includes all labor, materials and equipment associated with the minor demolition and removal of debris from the site as indicated on the Plans.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Demolition Schedule: Indicate overall schedule and interruptions required for utility and building services.

C. Shop Drawings:
1. Indicate demolition and removal sequence.
2. Indicate location of items designated for Owner's retention.
3. Indicate location and construction of temporary work.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements.

B. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, and subsurface obstructions.

C. Operation and Maintenance Data: Submit description of system, inspection data, and parts lists.

1.5 QUALITY ASSURANCE

A. Conform to applicable code for demolition work, dust control, products requiring electrical disconnection and re-connection.

B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.

C. Obtain required permits from authorities having jurisdiction.

1.6 SCHEDULING

A. Schedule Work to coincide with new construction.

B. Cooperate with Owner in scheduling noisy operations and waste removal that may impact Owners operation.

C. Coordinate utility service interruptions with Owner.
   1. Do not disable or disrupt building existing utility systems without two days prior written notice to Owner.
   2. Schedule tie-ins to existing systems to minimize disruption.

1.7 PROJECT CONDITIONS

A. Conduct demolition to minimize interference with adjacent and occupied building areas.

B. Cease operations immediately if structure appears to be in danger and notify Engineer. Do not resume operations until directed.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

A. Notify affected utility companies before starting work and comply with their requirements.

B. Mark location and termination of utilities.

C. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the public.

3.2 SALVAGE REQUIREMENTS

A. Coordinate with Owner to identify items and equipment required to be removed and delivered to Owner.

B. Tag components and equipment Owner designates for salvage.

C. Protect designated salvage items from demolition operations until items can be removed.

D. Carefully remove items and equipment indicated to be salvaged.

E. Disassemble as required to permit removal.

F. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

3.3 DEMOLITION

A. Conduct demolition to minimize interference with adjacent and occupied building areas.

B. Do not close or obstruct roadways or walkways without permits.

C. Cease operations immediately when structure appears to be in danger and notify Engineer.

D. Disconnect and remove designated utilities within demolition areas.

E. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.

F. Demolish in orderly and careful manner. Protect existing facilities.

G. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.

H. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.

I. Remove temporary Work.

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Preparing of subgrade and grading for buildings, slabs, walks, embankments, slopes and pavements.
   2. Excavating and backfilling of utility trenches.

B. Related Documents
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Base Material:
   1. Basis of Measurement: Cubic Yard
   2. Basis of Payment: Includes all labor, material, and equipment associated with placing the specified base material in accordance with the requirements outlined in this Section and/or in the Plans.

B. Aggregate:
   1. Basis of Measurement: Cubic Yard
   2. Basis of Payment: Includes all labor, material, and equipment associated with placing the specified aggregate material in accordance with the requirements outlined in this Section and/or in the Plans.

C. Structural Fill:
   1. Basis of Measurement: Cubic Yard
   2. Basis of Payment: Includes all labor, material, and equipment associated with placing structural fill material in accordance with the requirements outlined in this Section and/or in the Plans.

D. General Fill:
   1. Basis of Measurement: Cubic Yard
      Basis of Payment: Includes all labor, material, and equipment associated with placing general fill material in accordance with the requirements outlined in this Section and/or in the Plans.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO R 18 – Establishing and Implementing a Quality System for Construction Materials Testing Laboratories.

B. ASTM International:

1. ASTM D 698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil in place by the Sand-Cone Method
3. ASTM D 1557 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
4. ASTM D 2487 – Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
5. ASTM D 2922 – Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (shallow depth).
6. ASTM D 2937 – Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
7. ASTYM D 3017 – Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (shallow depth).
8. ASTM D 4318 – Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils
9. ASTM D 4959 – Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating.
10. ASTM D 6913 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
11. ASTM D 7830 Standard Test Method for In-Place Density and Water Content of Soil Using an Electromagnetic Soil Density Gauge

1.4 DEFINITIONS

A. Excavation: Removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.

B. Unauthorized excavation: Removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by the Engineer, shall be at the Contractor's expense.

1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Engineer.
2. In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by the Engineer.

C. Additional Excavation: When excavation has reached required subgrade elevations, notify Engineer, who will evaluate conditions. If Engineer determines that bearing materials at required subgrade are unstable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by Engineer. The Contract Sum may be adjusted by an appropriate Contract Modification.

1. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.

D. Subgrade: The undisturbed soil or rock, or the compacted fill layer immediately below structures, granular base, drainage fill, or topsoil materials.

E. Structures: Buildings, foundations, slabs, tanks, pavements, gravel drives or road, walks, curbs, cut slopes, fill embankments, utilities, or other man-made stationary features occurring above or below ground surface.

F. Structural Areas: Those plan locations containing a structure plus a minimum of 5 feet beyond the outside edge of the structure including appurtenances or as defined elsewhere in the project documents.

G. Structural Fill: Materials placed as fill in Structural Areas.

1.5 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Materials Source: Submit name of imported materials source.

C. Test Reports: All test reports must be completed under the supervision of a registered engineer, licensed in the state in which the project is located. Contractor will notify testing agency a minimum of 24 hours prior to performing work that requires testing. Submit the following test reports directly to Engineer, with copy to Contractor:

1. Test reports on borrow material. (ASTM D-2487, 4318, 6913)
2. Verification of each foundation bearing surface in accordance with specified requirements.
3. Field reports of in-place density tests.
4. One optimum moisture-maximum density curve for each type of soil encountered. (ASTM D-698 or ASTM D-1557)
5. Subgrade evaluation report for all structural areas prior to fill placement and after establishing final subgrade, but prior to pavement or building slab construction.

1.6 QUALITY ASSURANCE

A. Furnish each soil material from single source throughout the Work.

B. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

C. Testing and Inspection Service: Contractor will employ and pay for a qualified independent geotechnical testing and inspection laboratory in accordance with Section 01200 to perform soil testing and inspection service during earthwork operations. Laboratory shall be selected by the Engineer.

D. Testing Laboratory Qualifications: To qualify for acceptance, the geotechnical testing laboratory must demonstrate to Engineer's satisfaction, based on evaluation of laboratory submitted criteria conforming to AASHTO R18, that it has the experience and capability to conduct the required field and laboratory geotechnical testing.

1.7 PROJECT CONDITIONS

A. Site Information: Data in subsurface investigation reports (if performed) was used for the basis of the design and are available to the Contractor for information only. Conditions noted in the report(s) are not intended as representations or warranties of accuracy or

continuity between soil borings. The Owner and Engineer will not be responsible for interpretations or conclusions drawn from this data by Contractor.

1. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.

B. Existing Utilities: Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.

1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner at no expense to the Owner.

2. Do not interrupt existing utilities serving facilities occupied by Owner or others during occupied hours, except when permitted in writing by Engineer and then only after acceptable temporary utility services have been provided.

   a. Provide minimum of 48-hour notice to Engineer and receive written notice to proceed before interrupting any utility.

3. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active. Resultant excavations must be backfilled in lifts and tested in accordance with the project requirements.

C. Use of Explosives: Use of explosives is permitted. See Section 02316.

D. Jobsite safety and conformance to applicable codes and guidelines to protect persons and property is solely the responsibility of the contractor.

1. Excavate in accordance with OSHA guidelines. Barricade open excavations.
2. Operate safety barriers, markings and warning lights as required to maintain a safe work environment and as recommended by authorities having jurisdiction.
3. Protect structures, utilities, sidewalks, pavements, and other facilities to remain from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
4. Perform excavation by hand within dripline of large trees to remain. Protect root systems from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.

PART 2 PRODUCTS

A. Base Material: Naturally or artificially graded mixture of crushed gravel or stone, sand or select granular materials conforming to the Department of Transportation requirements for the state in which the project is located.

B. Aggregate: Graded fine or coarse aggregates as specified in Section 02060.

C. Structural Fill: On or off-site soil free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Material shall have a liquid limit of 50 or less, a plasticity index of 25 or less, less than 20% rock fragments retained on a ¾" sieve, and a maximum dry density of at least 100 pcf. May also consist of Aggregate Type A2, Type A3 or Crushed Aggregate Base Course.

B. General Fill: On or off-site soil and/or rock which is stable and can be compacted to the specified density. Rock fragments shall be less than 4 inches in largest dimension and blended with sufficient fines to create a dense fill mass free of visible voids.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavate topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas as directed by the Engineer.

B. Stockpile excavated material meeting requirements for satisfactory soil materials and topsoil materials.

C. Remove excess excavated material not intended for reuse from site.

D. Excavate to subgrade elevations or cut line as indicated, regardless of character of materials and obstructions encountered, including rock, existing structures, and utilities. Subsurface materials are unclassified.

3.2 STABILITY OF EXCAVATIONS

A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction. Design of retaining structures must be performed, signed and sealed by a registered engineer licensed in the state in which the project is located.

B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

1. Provide permanent steel sheet piling or reinforced concrete drilled shaft walls wherever subsequent removal of retaining structure might permit lateral movement of soil under adjacent structures. Cut off tops a minimum of 2'-6" below final grade and leave permanently in place.

3.3 DEWATERING

A. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

1. Do not allow water to accumulate in excavations or in foundation excavations prior to or following footing construction. Remove water to prevent softening of foundation boring soils, undercutting footings, and soil changes detrimental to stability of the subgrade and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.
3. Dewater excavations only as necessary for suitable construction. Do not continue dewatering overnight or for an extended period of time except as required.

3.4 STORAGE OF EXCAVATED MATERIALS

A. Stockpile excavated materials acceptable for backfill and fill where directed. Place, grade, and shape stockpiles for proper drainage. Stabilize in accordance with ADEM and NPDES regulations.

1. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
2. Dispose of excess excavated soil material and materials not acceptable for reuse as backfill or fill.

3.5 EXCAVATION FOR STRUCTURES

A. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection.

1. Excavations for footings and foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim sides and bottom to required lines and grades. Compact with hand or remote operated equipment to leave solid base to receive other work.
2. For pile foundations, stop excavations from 6 inches to 12 inches above bottom of cap before piles are placed. After piles have been placed, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. Excavations for soil supported foundations must be neat, clean and dry. Remove loose, disturbed and soft soil. Dewater only as necessary for proper construction.

3.6 EXCAVATION FOR PAVEMENTS

A. Cut surface under pavements to comply with cross-sections, elevations and grades as indicated.

3.7 TRENCH EXCAVATION FOR PIPES AND CONDUIT

A. Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of 36 inches total width.

B. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on structural fill or undisturbed soil and bedding material. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

1. Where rock is encountered, refer to Section 02316 – Rock Removal. No direct payment will be made for rock removal, unless specified in other sections.
2. For pipes or conduit in all other soil conditions, refer to Section 02324 – Utility Trenching.

3.8 COLD WEATHER PROTECTION

A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

B. Do not place frozen soil fill.

3.9 BACKFILL AND FILL

A. General: Place soil material in uniform, horizontal lifts as required to final subgrade elevations. Compact individual lifts uniformly to specified density prior to placing the subsequent lift. For each area classification listed below, use materials specified in Part 2 of the Section.

1. In non-structural areas, use general fill. The final lift shall be the required thickness of topsoil.
2. In structural areas, use structural fill or aggregate. The final lift shall be as indicated on the plans.
3. Under utilities, use aggregate as indicated on the plans in areas determined by the Engineer to be unsuitable for pipe bedding. Shape excavation bottom to fit bottom 90 degrees of cylinder.
4. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings or that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.
   a. Concrete is specified in Section 03300.
   b. Do not backfill trenches until tests and inspections have been made and backfilling is authorized by Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.
5. Provide 4-inch-thick concrete base slab support for piping or conduit less than 24” below surface of roadways. After installation and testing of piping or conduit, provide minimum 4-inch-thick encasement (sides and top) of concrete prior to backfilling or placement of roadway base.

B. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Acceptance of construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.
2. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
3. Removal of concrete formwork.
4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
5. Removal of trash and debris from excavation.
6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

3.10 PLACEMENT AND COMPACTION

A. Ground Surface Preparation: Remove vegetation, debris, topsoil, obstructions, underground structures (foundations, slabs, walls and utilities), and deleterious materials from area prior to placement of fills. Backfill disturbed areas with compacted and tested fill. Contractor shall notify Engineer to evaluate the natural ground prior to fill placement. Where access permits, Contractor shall provide pneumatic-tired equipment capable of producing the pressure equal to that produced by a fully-loaded, tri-axle dump truck for use in evaluation.

1. When existing ground exhibits instability, scarify ground surface, moisture-condition to within 2% of the optimum moisture content, and compact to the project requirements. Alternatively, remove and replace unstable soils with suitable, compacted soils or stabilize at the direction of the Engineer.
2. Bench sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface. Benches shall consist of alternating horizontal and vertical soil surfaces in the original ground with horizontal benches no more than 5 feet apart vertically.
3. Overbuild slopes and cut back to the desired configuration to ensure the soils at the slope face are properly compacted and tested.

B. In structural areas, place structural fill or aggregate in layers not more than 8 inches in loose thickness for material compacted by heavy compaction equipment, and not more than 4 inches in loose-thickness for material compacted by hand-operated tampers. In non-structural areas, place general fill in maximum 24" thick lifts.

C. In structural areas, before compaction, moisten or aerate each layer of fill as necessary to provide moisture content within the fill at ±2% of the optimum moisture content. Compact each layer to required percentage of maximum dry density for each area classification. Do not place structural fill on surfaces that are muddy, frozen, or contain frost or ice.

D. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping

or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

E. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by Engineer if soil density tests indicate inadequate compaction.

1. Percentage of Maximum Standard Proctor Density Requirements:
   a. Structural Areas: Compact each individual lift of structural fill and fine aggregate to not less than 98% of the maximum standard Proctor density in accordance with ASTM D-698. Compact each individual lift of coarse aggregate using multiple passes of a vibratory compactor or as directed by the Engineer.
   b. Non-Structural Areas: Compact each individual lift using multiple passes of a compactor designed for the type of soils used as fill or backfill.
2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
   a. Remove and replace, or scarify and air dry soil material that is too wet to permit compaction to specified density.
   b. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

3.11 GRADING

A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition area. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes and as follows:

1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.
2. Walks: Shape surface of areas under walks to line, grade, and cross-section, with finish surface not more than 0.10 foot above or below required subgrade elevation.
3. Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than ½ inch above or below required subgrade elevation.

C. Grading Surface of Fill under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of ½ inch.

D. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.12 PAVEMENT BASE COURSE

A. General: Base course consists of placing base material in layers of specified thickness, over subgrade surface to support a pavement base course.
   1. Refer to other Division 2 sections for paving specifications.

B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of base course.

C. Shoulders: Place shoulders along edges of base course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each base course layer. Compact and roll at least a 12-inch width of shoulder simultaneous with the compaction and rolling of each layer of base course.

D. Placing: Place base course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting base material during placement operations.
   1. When a compacted base course is indicated to be 6 inches thick or less, place material in a single layer. When indicated to be more than 6 inches thick, place material in equal layers, except no single layer more than 6 inches or less than 3 inches when compacted.
   2. Compact individual lifts of the base to a minimum of 100% of the ASTM D-1557 maximum dry density at ±2% of the optimum moisture content.

3.13 BUILDING SLAB DRAINAGE COURSE

A. General: Drainage course consists of placing aggregate in layers of indicated thickness over subgrade surface to support concrete building slabs.

B. Placing: Place aggregate on prepared subgrade in layers of uniform thickness, conforming to the indicated cross-section and thickness. Maintain optimum moisture content for compacting material during placement operations.
   1. When a compacted drainage course is indicated to be 6 inches thick or less, place material in a single layer. When indicated to be more than 6 inches thick, place material in equal layers, except no single layer shall be more than 6 inches or less than 3 inches when compacted.
   2. Compact the individual lifts of the drainage course with a vibratory compactor as directed by the Engineer.

3.14 FIELD QUALITY CONTROL

A. Quality Assurance consisting of testing and observation of a limited sampling of construction materials will be paid for using the testing allowance for acceptance purposes. Passing test results are not a warranty, guarantee, or certification by the testing agency, Engineer, or Owner that all work was performed in conformance with the plans and specifications. Therefore, the Contractor should not rely solely on test results generated by the quality assurance process as an indication of the suitability of the construction.

B. It is entirely the Contractor's responsibility to perform quality control as necessary to construct the project in conformance with the plans and specifications. Deviations from

the plans and specifications, whether identified during construction or following the completion of construction, must be corrected by the Contractor at no cost to the Owner.

C. Quality Control Testing During Construction: Allow testing service (to be selected by Engineer) to test each subgrade and fill layer before further backfill or construction work is performed.

1. Perform field density tests on each lift of fill in accordance with ASTM D 2937 (Drive Cylinder Method), ASTM D 2922 (Nuclear Method), ASTM D 7830 (Electromagnetic Method), or ASTM D 1556 (sand cone method).

   a. In conjunction with each density test, the natural moisture content shall be determined in accordance with ASTM D 3017 (nuclear method), ASTM D 4959 (direct heating), ASTM D 7830 (electromagnetic method) or other method approved by the Engineer.
   b. If field tests are performed using nuclear or electromagnetic methods, make calibration checks using alternate methods of both density and moisture results on each different type of material encountered and at intervals as directed by the Engineer.

2. Footing Subgrade: For all soil on which footings will be placed, perform tests to verify required design bearing capacities. Engineer shall be notified to observe and approve each footing subgrade. Engineering evaluation may include the excavation of hand augers or test pits. The contractor shall provide suitable equipment to excavate test pits as directed by the Engineer.
3. Paved Areas and Building Slab Subgrade: Perform at least one field density test per lift for every 2,500 sq. ft. of area, but in no case fewer than three tests.
4. Foundation Wall Backfill: Perform at least two field density tests on each lift of fill placed at locations directed by the Engineer.

D. If in opinion of Engineer, based on testing reports or Engineering judgement, subgrade or fill that have been placed are unsuitable, perform additional compaction and testing until specified density is obtained. Do not place additional fill over materials that have not been approved by the Engineer. Work to recompact and retest unsuitable areas will be at the expense of the contractor.

3.15 EROSION CONTROL

A. Provide erosion control methods in accordance with requirements of authorities having jurisdiction and/or as described in the Plans.

B. Unless otherwise specified in the Plans, the contractor is responsible to apply for and obtain any required permits in the contractor's name associated with current NPDES guidelines. Requirements for implementing and maintaining an acceptable Best Management Practices Plan shall be the responsibility of the contractor. The contractor is responsible to maintain the NPDES permit in good standing with the regulatory authority and comply with applicable NPDES regulations during construction, and terminate permit upon completion and approval at no additional cost to the owner.

3.16 MAINTENANCE

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.

C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

D. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.17 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash, and debris, and dispose of it off Owner's property.
   1. Secure a disposal site and all necessary approvals for use.
   2. Remove excess excavated material, trash, debris, and waste materials and dispose of it off Owner's property.
   3. Excavated material in area noted on plans shall be screened by geotechnical engineer. If classified "contaminated", it shall be stockpiled and monitored by the contractor at no additional cost.

END OF SECTION

SECTION 02324

UTILITY TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavating trenches for utilities.
   2. Backfilling and compaction.

B. Related Sections:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Basis of Measurement and Payment shall be as outlined in Sections related to the specific Utility being installed.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:
   1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
   3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
   4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
   6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.4 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

B. Structures: Buildings, foundations, slabs, tanks, pavements, walks, curbs, cut slopes, fill embankments, utilities, or other man-made stationary features occurring above or below ground surface.

C. Structural Areas: Those plan locations containing a structure plus a minimum of 5 feet beyond the outside edge of the structure including appurtenances or as defined elsewhere in the project documents.

D. Structural Fill: Materials placed as fill in Structural Areas.

1.5 SUBMITTALS

A. Product Data: Submit data for geotextile fabric indicating fabric and construction.

B. Materials Source: Submit name of imported fill materials suppliers.

1.6 QUALIFICATIONS

A. Prepare erosion control plan and submit to Engineer prior to start of construction.

B. Refer to Section 02374, Erosion Control Devices.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. General fill: As specified in Section 02300.

B. Aggregate Fill: As specified in Section 02300, Section 02060, and the Plans.

C. Structural Fill: As specified in Section 02300.

D. Concrete: Structural concrete as specified in Section 03300 with compressive strength of 3,000 psi.

E. Lean Concrete: Non-structural concrete with a compressive strength of 2,000 psi.

PART 3 EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.
   1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

C. Maintain proper horizontal alignment of utilities not laid on grade.

3.2 PREPARATION

A. Call Alabama One Call service at 1-800-292-8525 not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum locations.

C. Protect plant life, lawns, and other features remaining as portion of final landscaping.

D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities indicated to remain.

F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

A. Erect erosion control devices prior to excavation.

B. Excavate subsoil required for utilities to the depth indicated on the Drawings.

C. Remove lumped subsoil, boulders, and rock up of 1/6 cubic yard, measured by volume. Remove larger material as specified in Section 02316.

D. Perform excavation within 24 inches of existing utility in accordance with utility's requirements.

E. Do not advance open trench more than 400 feet ahead of installed pipe.

F. Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of 12 inches of clearance on each side of pipe or conduit.

G. Remove water or materials that interfere with Work.

H. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil and bedding material. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

I. Do not interfere with 45 degree bearing splay of building foundations or roadbeds.

J. When subsurface materials at bottom of trench are loose or soft, notify Engineer, and request instructions.

K. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Fill Type A1 and compact to density equal to or greater than requirements for subsequent backfill material.

L. Correct over excavated areas with compacted backfill as specified for authorized excavation or replace with concrete as directed by Engineer.

M. Remove excess subsoil not intended for reuse, from site.

N. Maintain trench depth sufficient to provide a minimum cover of 30 inches over utility pipe unless otherwise noted in the Drawings. Maintain a minimum of 36 inches cover under highway ditches.

3.4 STABILITY OF EXCAVATIONS

A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction. Design of retaining structures must be performed, signed and sealed by a registered engineer licensed in the state in which the project is located.

B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

1. Provide permanent steel sheet piling or reinforced concrete drilled shaft walls wherever subsequent removal of retaining structure might permit lateral movement of soil under adjacent structures. Cut off tops a minimum of 2’-6” below final grade and leave permanently in place.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

A. Backfill trenches as follows:

1. In non-structural areas, use excavated material to backfill to existing contours and elevations, unless such material does not conform to the requirements of General Fill as outlined in Section 02300. In such instances, borrow material meeting those requirements shall be brought in to backfill the trench. The final lift shall be the required thickness of topsoil.
2. In structural areas, use structural fill as shown on the Plans or as directed by the Engineer. Backfill to elevations reflected on the plans, or to match surrounding grade. The final lift shall be as indicated on the plans. If subgrade is unstable, prepare subgrade beneath pipe in accordance with Section 2300 prior to fill placement.
3. Use aggregate as indicated on the plans in areas determined by the Engineer to be unsuitable for pipe bedding. Shape excavation bottom to fit bottom 90 degrees of cylinder.
4. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings or that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.
    a. Concrete is specified in Section 03300.
    b. Do not backfill trenches until tests and inspections have been made and backfilling is authorized by Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.
5. Provide 4-inch-thick concrete base slab support for piping or conduit less than 24" below surface of roadways. After installation and testing of piping or conduit, provide minimum 4-inch-thick encasement (sides and top) of concrete prior to backfilling or placement of roadway base.

B. Place, moisture condition, and compact fill material in accordance with Section 02300.

C. Employ placement method that does not disturb or damage utilities in trench, or structures near the trench.

D. Do not leave trench open at end of working day.

3.6 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

SECTION 02374

EROSION CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Silt Fences.
   2. Diversion Channels.
   3. Rock Energy Dissipater.
   4. Paved Energy Dissipater.
   5. Rock Basin.
   6. Rock Barriers.
   7. Sediment Ponds.
   8. Sediment Traps.

B. Related Sections:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T88 - Standard Specification for Particle Size Analysis of Soils.
   2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.

C. ASTM International:
   1. ASTM C127 - Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
   2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
   3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D. Precast/Prestressed Concrete Institute:
   1. PCI MNL-116S - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Product Data: Submit data on joint filler joint sealer and geotextile.

C. Submit Erosion Control Plan along with application for Stormwater NPDES permit to Engineer prior to placement of erosion control devices.

D. Submit manufacturer's catalog sheets and other pertinent information on filter fabrics showing that they meet or exceed the requirements of this specification.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Section 01600 - Product Requirements.

B. Do not place grout when air temperature is below freezing.

C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

D. Silt fence should not be installed across streams, ditches, waterways, or other concentrated flow areas.

PART 2 PRODUCTS

2.1 SILT FENCE MATERIALS

A. Geotextile fabric shall be a 36" wide, nonwoven filter fabric composed of polypropylene, polyethylene, ethylene, or polyamide material.

B. Minimum grab strength shall be 100 lbs. in any direction.

C. Apparent opening size shall be 30 (maximum sieve size).

D. Flow rate shall be 25 gallons/minute/square foot.

E. Ultraviolet ray inhibitors and stabilizers shall provide a maximum of 6 months of expected usable life.

F. Type A silt fence shall include a 36" wide, 12-1/2 gauge galvanized wire fence reinforcement to be placed with the geotextile material. Wire fence shall have openings no larger than 6 inches by 6 inches. Type B silt fence shall be a 36" wide fabric with no wire fence reinforcement.

G. Fence posts shall be minimum 2” x 2” oak, 60” long or steel T-post for Type B silt fence. Steel T-posts or 4” x 4” pressure treated wood posts shall be required for Type A silt fence. Minimum bury depth for wood posts is 24 inches.

2.2 ROCK

A. Rock: Sound, hard and angular shape; well graded; without shale seams, structural defects and foreign substances; with width and thickness greater than one third its length. Refer to Section 02371.

2.3 CONCRETE MATERIALS AND REINFORCEMENT

A. Concrete: As specified in Section 03300.

B. Water: Clean and not detrimental to concrete.

C. Reinforcement Steel: As specified in Section 03200.

2.4 BLOCK, STONE, AGGREGATE, AND SOIL MATERIALS

A. Precast Solid Concrete Block.

B. Soil Backfill: Soil as specified in Section 02300.

2.5 PLANTING MATERIALS

A. Seeding and Soil Supplements: As specified in Section 02924.

B. Mulch: As specified in Section 02924.

2.6 PIPE MATERIALS

A. Pipe: Corrugated Plastic (HDPE).

2.7 SOURCE QUALITY CONTROL (AND TESTS)

A. Section 01400 - Quality Requirements.

B. Perform tests on cement, aggregates, and mixes to ensure conformance with specified requirements.

C. Make rock available for inspection at producer’s quarry prior to shipment. Notify Engineer at least seven days before inspection is allowed.

D. Allow witnessing of inspections and testing at manufacturer’s test facility. Notify Engineer at least seven days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Verify location of existing streams, drainage structures and environmentally sensitive areas prior to placing erosion control devices.

C. Verify compacted subgrade, granular base or stabilized soil is acceptable and ready to support devices and imposed loads.

D. Verify gradients and elevations of base or foundation for other work are correct.

3.2 SILT FENCE

A. The silt fence should be purchased in a continuous roll cut to length to avoid the use of joints. When joints are unavoidable, fabric should be spliced together at a post with a minimum 6 inch overlap.

B. Post installation should start at the center of the low point with remaining posts spaced 10 feet apart for Type A and 7 feet apart for Type B fence.

C. Anchor fabric by entrenching the bottom edge in a 6 inch deep trench and backfilling.

D. Hay or straw bales shall be placed at each end of the silt fence.

3.3 DIVERSION CHANNELS

A. Windrow excavated material on low side of channel.

B. Compact to 95 percent maximum density.

C. On entire channel area, apply soil supplements and sow seed as specified in Section 02924.

D. Mulch seeded areas with hay as specified in Section 02924.

3.4 ROCK ENERGY DISSIPATOR

A. Excavate to indicated depth of rock lining or nominal placement thickness as follows. Remove loose, unsuitable material below bottom of rock lining, then replace with suitable material. Thoroughly compact and finish entire foundation area to firm, even surface.

NCSA Class	Nominal Placement Thickness
R8	48 inches
R7	36 inches
R6	30 inches
R5	24 inches
R4	18 inches
R3	12 inches

B. Lay and overlay geotextile fabric over substrate. Lay fabric parallel to flow from upstream to downstream. Overlap edges upstream over downstream and upslope over downslope. Provide a minimum overlap of 3 feet. Offset adjacent roll ends a minimum of 5 feet when lapped. Cover fabric as soon as possible and in no case leave fabric exposed more than 4 weeks.

C. Carefully place rock on geotextile fabric to produce an even distribution of pieces, with minimum of voids and without tearing geotextile.

D. Unless indicated otherwise, place full course thickness in one operation to prevent segregation and to avoid displacement of underlying material. Arrange individual rocks for uniform distribution.
   1. Saturate rock with water. Fill voids between pieces with grout, for at least top 6 inches. Sweep surface with stiff broom to remove excess grout.
   2. Moist cure grouted rock for at least 3 days after grouting, using water saturated burlap in accordance with Section 03300.

3.5 PAVED ENERGY DISSIPATER

A. Excavate to the required paving depth. Remove loose, unsuitable material below bottom of paving, and then replace with suitable material. Thoroughly compact and finish entire foundation area to firm, even surface.

B. Place forms and hold reinforcement firmly in position during placing of concrete.

C. Mix, place and finish concrete, as specified in Section 03300.

D. Embed stones or blocks 4 inches in plastic concrete at indicated separation on slopes and channel bottom.

E. Pave in uniform 10 foot lengths or sections.

F. Pave in shorter sections as necessary for closures or curves.

G. Place premolded expansion joint filler, 1/2 inch thick, cut to conform to paving cross sections, at ends of curved sections at intervals of not more than 100 feet, at end of day's work, and where paving is adjacent to rigid structure. Use joint filler with depth of 1/2 inch less than paving depth and press firmly against adjacent concrete.

H. Form intermediate joints between sections, with two thicknesses of bituminous paper cut neatly to paving cross section.

3.6 ROCK BASIN

A. Construct generally in accordance with rock energy dissipator requirements to indicated shape and depth. Rock courses may be placed in several operations but minimum depth of initial course must be 3 feet or greater.

3.7 ROCK BARRIER

A. Determine length required for ditch or depression slope and excavate compact and foundation area to firm, even surface.

B. Produce an even distribution of rock pieces, with minimum voids to the indicated shape, height and slope.

C. Construct coarse aggregate filter blanket against upstream face of rock barrier to the indicated thickness.

3.8 SEDIMENTATION POND

A. Clear and grub storage area and embankment foundation area site as specified in Section 02230.

B. Excavate key trench for full length of dam. Excavate emergency spillway in natural ground.

C. Install pipe spillway, with anti-seep collar attached, at location indicated.

D. Place forms and reinforcing for concrete footing at bottom of riser pipe with trash rack and anti-vortex device, as specified in Section 03200. Construction of embankment and trench prior to placing pipe is not required.

E. Mix, place, finish, and cure concrete, as specified in Section 03300.

F. Do not use coarse aggregate as backfill material around pipe. Backfill pipe with suitable embankment material to prevent dam leakage along pipe.

G. Construct rock basin at outlet end of pipe, as specified in this Section. Place embankment material, as specified in Section 02300. When required, obtain borrow excavation for formation of embankment, as specified in Section 02300.

H. On entire sedimentation pond area, apply soil supplements and sow seed as specified in Section 02924.

I. Mulch seeded areas with hay as specified in Section 02924.

3.9 SEDIMENT TRAPS

A. Clear site, as specified in Section 02230.

B. Construct trap by excavating and forming embankments as specified in Section 02300.

C. Place coarse aggregate or rock at outlet as indicated on Drawings.

D. Place geotextile fabric, as specified for rock energy dissipater.

E. When required, obtain borrow excavation for formation of embankment, as specified in Section 02300.

F. On entire sediment trap area, apply soil supplements and sow seed as specified in Section 02924.

G. Mulch seeded areas with hay as specified in Section 02924.

3.10 SITE STABILIZATION

A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.

B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.

C. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
1. During non-germinating periods, apply mulch at recommended rates.
2. Stabilize disturbed areas which are not at finished grade and which will be disturbed within one year in accordance with Section 02924 at 90 percent of permanent application rate with no topsoil.
3. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year in accordance with Section 02924 permanent seeding specifications.

D. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.11 FIELD QUALITY CONTROL

A. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.

B. Sediment should be removed from behind silt fence once it has accumulated to one-half the original height of the barrier. Fabric should be replaced whenever it has deteriorated to such an extent that the effectiveness of the fabric is reduced (approximately six months).

C. Hay bales shall be replaced every 6 months regardless of condition.

D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

E. Do not damage structure or device during cleaning operations.

F. Do not permit sediment to erode into construction or site areas or natural waterways.

G. Clean channels when depth of sediment reaches approximately one half channel depth.

END OF SECTION

SECTION 024520 - AGGREGATE PIER GROUND IMPROVEMENT

PART 1 - GENERAL REQUIREMENTS

1.1 DESCRIPTION

A. Work shall consist of designing, furnishing and installing aggregate pier ground improvement to the lines and grades designated on the project foundation plan and as specified herein. Aggregate pier ground improvement as referenced in this specification shall be constructed by either vibro stone columns or Rammed Aggregate Pier® systems. The aggregate piers shall be in a columnar-type configuration and shall be used for support of foundation loads.

1.2 WORK INCLUDED

B. Provision of all equipment, material, labor, and supervision to design and install aggregate piers. Design shall rely on subsurface information presented in the project geotechnical report. Layout of aggregate piers, spoil removal (as required), footing excavations, and subgrade preparation following aggregate pier installation is not included.

C. The aggregate pier design and installation shall adhere to all methods and standards described in this Specification.

D. Drawings and General Provisions of the Contract, including General and Supplemental Conditions, and Division 1 Specifications, apply to the work in this specification.

1.3 APPROVED INSTALLERS

A. The Aggregate Pier Installer (the Installer) shall be approved by the Owner's Engineer prior to bid opening. Without exception, no alternate installer will be accepted unless approved by the Owner's Engineer at least two (2) weeks prior to bid opening.

B. Installers of aggregate pier foundation systems shall have a minimum of 5 years of experience with the installation of aggregate pier systems and shall have completed at least 50 projects.

1.4 REFERENCE STANDARDS

A. Design

1. "Control of Settlement and Uplift of Structures Using Short Aggregate Piers," by Evert C. Lawton (Assoc. Prof., Dept. of Civil Eng., Univ. of Utah), Nathaniel S. Fox (President, Geopier Foundation Co., Inc.), and Richard L. Handy (Distinguished Prof. Emeritus, Iowa State Univ., Dept. of Civil Eng.), reprinted from IN-SITU DEEP SOIL IMPROVEMENT, Proceedings of sessions sponsored by the Geotechnical Engineering Division/ASCE in conjunction with the ASCE National Convention held October 9-13, 1994, Atlanta, Georgia.

2. "Settlement of Structures Supported on Marginal or Inadequate Soils Stiffened with Short Aggregate Piers," by Evert C. Lawton and Nathaniel S. Fox. Geotechnical Special Publication No. 40: Vertical and Horizontal Deformations of Foundations and Embankments, ASCE, 2, 962-974.
3. "Behavior of Geopier®-Supported Foundation Systems during Seismic Events," by Kord Wissmann, Evert C. Lawton, and Tom Farrell. Geopier Foundation Company, Inc. Blacksburg, VA ©1999.
4. "The design of vibro replacement." H.J. Priebe. Ground Engineering, London. Dec 1995.

B. Modulus Testing

1. ASTM D 1143 - Pile Load Test Procedures
2. ASTM D 1194 - Spread Footing Load Test

C. Materials and Inspection

1. ASTM D 1241 - Aggregate Quality
2. ASTM D 422 - Gradation of Soils

D. Where specifications and reference documents conflict, the Aggregate Pier Designer shall make the final determination of the applicable document.

1.5 CERTIFICATIONS AND SUBMITTALS

A. Design Calculations - The Installer shall submit detailed design calculations and construction drawings prepared by the Aggregate Pier Designer (the Designer) for review and approval by the Owner or Owner's Engineer. All plans shall be sealed by a Professional Engineer in the State in which the project is constructed.

B. Professional Liability Insurance - The Aggregate Pier Designer shall have Errors and Omissions design insurance for the work. The insurance policy should provide a minimum coverage of $3 million per occurrence.

C. Building Code Acceptance – The Aggregate Pier Installer shall demonstrate that the Aggregate Pier system has been evaluated by the International Code Council (formerly ICBO).

D. Modulus Test Reports – A modulus test(s) is performed on a non-production Aggregate Pier element as required by the Aggregate Pier Designer to verify the design assumptions. The Installer shall furnish the General Contractor a description of the installation equipment, installation records, complete test data, analysis of the test data and verification of the design parameter values based on the modulus test results. The report shall be prepared under direction of a Registered Professional Engineer.

E. Daily Aggregate Pier Progress Reports – The Installer shall furnish a complete and accurate record of Aggregate Pier installation to the General Contractor. The record shall indicate the pier location, length, volume of aggregate used or number of lifts, densification forces during installation, and final elevations or depths of the base and top of piers. The record shall also indicate the type and size of the installation equipment used, and the type of aggregate used.

The Installer shall immediately report any unusual conditions encountered during installation to the General Contractor, to the Designer and to the Testing Agency.

PART 2 - MATERIALS

2.1 AGGREGATE

A. Aggregate used by the Aggregate Pier Installer for pier construction shall be pre-approved by the Designer and shall demonstrate suitable performance during modulus testing. Typical aggregate consists of Type 1 Grade B in accordance with ASTM D-1241-68, No. 57 stone, recycled concrete or other graded aggregate approved by the Designer.

B. Potable water or other suitable source shall be used to increase aggregate moisture content where required. The General Contractor shall provide such water to the Installer.

PART 3 - DESIGN REQUIREMENTS

3.1 AGGREGATE PIER DESIGN

A. The design of the Aggregate Pier system shall be based on the service load bearing pressure and the allowable total and differential settlement criteria of all footings indicated by the design team for support by the Aggregate Pier system. The Aggregate Pier system shall be designed in accordance with generally-accepted engineering practice and the methods described in Section 1 of these Specifications. The design life of the structure shall be 50 years.

B. The design shall meet the following criteria.

Maximum Allowable Bearing Pressure for gravity loads on Footings Supported by Aggregate Pier Reinforced Soils	4000 psf
Estimated Total Long-Term Settlement for Footings:	≤ 1-inch
Estimated Long-Term Differential Settlement of Adjacent Footings:	≤ ½-inch

3.2 DESIGN SUBMITTAL

A. The Installer shall submit detailed design calculations, construction drawings, and shop drawings, (the Design Submittal), for approval at least 2 week(s) prior to the beginning of construction. A detailed explanation of the design parameters for settlement calculations shall be included in the Design Submittal. Additionally, the quality control test program for Aggregate Pier system, meeting these design requirements, shall be submitted. All computer-generated calculations and drawings shall be prepared and sealed by a Professional Engineer, licensed in the State or Province where the piers are to be built. Submittals will be submitted electronically only unless otherwise required by specific submittal instructions.

PART 4 - EXECUTION

4.1 APPROVED INSTALLATION PROCEDURES

A. The following sections provide general criteria for the construction of the Aggregate Piers. Unless otherwise approved by the Designer, the installation method used for Aggregate Pier construction shall be that as used in the construction of the successful modulus test.

B. Aggregate Piers Installed using augered Rammed Aggregate Pier systems –

1. Augered Rammed Aggregate Pier systems shall be pre-augered using mechanical drilling or excavation equipment.
2. If cave-ins occur during excavation such that the sidewalls of the hole are deemed to be unstable, steel casing shall be used to stabilize the cavity or a displacement Rammed Aggregate Pier system may be used.
3. Aggregate shall be placed in the augered cavity in compacted lift thicknesses no greater than 24 inches as determined by the Aggregate Pier Designer.
4. Should cave-ins occur on top of a lift of aggregate such that the volume of the caved soil is greater than 10 percent of the volume of the aggregate in the lift, then the aggregate shall be considered contaminated and shall be removed and replaced with uncontaminated aggregate.
5. A specially-designed beveled tamper and high-energy impact densification apparatus shall be employed to densify lifts of aggregate during installation. The tamper diameter shall be at least 80% of the pre-augered hole diameter. The apparatus shall apply direct downward impact energy to each lift of aggregate.

C. Aggregate Piers Installed using Displacement Rammed Aggregate Pier systems –

1. Displacement Rammed Aggregate Pier systems shall be constructed by advancing a specially designed mandrel with a minimum 15 ton static force augmented by dynamic vertical ramming energy to the full design depth. The hollow-shaft mandrel, filled with aggregate, is incrementally raised, permitting the aggregate to be released into the cavity, and then lowered by vertically advancing and/or ramming to densify the aggregate and force it laterally into the adjacent soil. The cycle of raising and lowering the mandrel is repeated to the top of pier elevation. The cycle distance shall be determined by the Rammed Aggregate Pier designer.
2. Special high-energy impact densification apparatus shall be employed to vertically densify the Rammed Aggregate Pier elements during installation of each approximate 1-foot thick constructed lift. The tamper diameter shall be at least 50% of the Aggregate Pier design diameter.
3. Downward crowd pressure shall be applied to the mandrel during installation.

D. Aggregate Piers Installed using Vibroflot Stone Columns

1. If vibroflot stone column construction is used to construct the Aggregate Piers, the Installer shall use an electric down-hole vibroflot (probe) capable of providing at least 200 HP of rated energy and a centrifugal force of 30 tons. The vibroflot diameter must be at least 60% of the Aggregate Pier design diameter. An appropriate metering device should be provided at such a location that inspection of amperage build-up may be verified during the operation of the equipment. Metering device may be an ammeter

directly indicating the performance of the vibroflot tip of the eccentric. Complete equipment specifications should be submitted to the Engineer prior to commencement of the fieldwork.

2. The probe and follower tubes shall be of sufficient length to reach the elevations shown on the installer's approved construction drawings. The probe, used in combination with the available pressure to the tip jet, shall be capable of penetration to the required tip elevation. Pre-augering shall be used to aid penetration.
3. The probe shall penetrate into the foundation soil layer to the minimum depths required in the installer's construction plans. After penetration to the required depth, the probe shall not be withdrawn more than 2 feet at any time unless the stone stops flowing to the bottom of the probe.
4. Redriving the probe into the treated depth shall be attempted at approximately 12 to 18-inch intervals to observe resistance to penetration and amperage build-up. During redriving, the probe tip shall penetrate to within 1 foot of the previous redriving depth.
5. Amperage build-up and backfill quantities will be contingent upon the type of probe used and procedures. Prior to commencement of work, the contractor shall discuss the equipment capabilities with the Engineer to determine if trial probes will be necessary.
6. The Installer shall provide a full-time quality control technician on-site during the installation process.

4.2 PLAN LOCATION AND ELEVATION OF AGGREGATE PIERS

A. Aggregate Pier elements installed beyond the maximum allowable tolerances shall be abandoned and replaced with new piers, unless the Designer approves the condition or provides other remedial measures. All material and labor required to replace rejected piers shall be provided at no additional cost to the Owner, unless the cause of rejection is due to an obstruction or mislocation.

PART 5 - QUALITY CONTROL

5.1 CONTROL TECHNICIAN

A. The Installer shall have a full-time, on-site Control Technician to verify and report all installation procedures. The Installer shall immediately report any unusual conditions encountered during installation to the Aggregate Pier Designer, the General Contractor, and to the Testing Agency. The quality control procedures shall include the preparation of Aggregate Pier Progress Reports completed during each day of installation containing the following information:

1. Footing and Aggregate Pier location.
2. Pre-auger diameter and soil conditions encountered during drilling (if required).
3. Aggregate Pier length.
4. Planned and actual Aggregate Pier elevations at the top and bottom of the Aggregate Pier.
5. Average lift thickness of each Aggregate Pier.
6. Volume of aggregate used in each Aggregate Pier.
7. Documentation of any unusual conditions encountered.
8. Type and size of densification equipment used

5.2 AGGREGATE PIER MODULUS TEST

A. When authorized, an Aggregate Pier Modulus Test(s) shall be performed at locations agreed upon by the Aggregate Pier Designer and the Testing Agency to verify or modify Aggregate Pier designs. Modulus Test Procedures shall utilize appropriate portions of ASTM D 1143 and ASTM D 1194, as outlined in the Aggregate Pier design submittal. Aggregate Piers shall be tested to 150 percent of the maximum design stress as shown in the aggregate pier design submittal. The modulus tests shall be of the type and installed in a manner specified herein.

B. A telltale shall be installed at the bottom of the test pier so that bottom-of-pier deflections may be determined. Acceptable performance is indicated when the bottom of the pier deflection is no more than 30% of the top of pier deflection at the design stress level.

C. ASTM D-1143 general test procedures shall be used as a guide to establishing load increments, load increment duration, and load decrements.

D. With the exception of the load increment representing approximately 117% of the design maximum top of Aggregate Pier stress, all load increments shall be held for a minimum of 15 minutes. Loads are then maintained until the rate of deflection reduces to 0.01 inch per hour or for the maximum of 1 hour, whichever is occurs first.

E. The load increment that represents approximately 117% of the design maximum stress on the Aggregate Pier shall be held for a minimum of 15 minutes. Loads are then maintained until the rate of deflection reduces to 0.01 inch per hour or for the maximum of 4 hours, whichever is occurs first.

F. A seating load equal to 5 percent of the total load shall be applied to the loaded steel plate prior to application of load increments and prior to measurement of deflections to compensate for surficial disturbance.

5.3 BOTTOM STABILIZATION TESTING (BSTS) /CROWD STABILIZATION/TESTING (CSTS)

A. Bottom stabilization testing (BSTs) or Crowd stabilization testing (CSTs) shall be performed by the Control Technician during the installation of the modulus test pier. The tests are performed by applying downward vertical energy to the tamper, mandrel or probe following lift construction and monitoring the amount of additional deflection from the applied energy. Additional testing as required by the Aggregate Pier Designer (typically 10% of the production Aggregate Piers) shall be performed on selected production Aggregate Pier elements to compare results with the modulus test pier.

PART 6 - QUALITY ASSURANCE

6.1 INDEPENDENT ENGINEERING TESTING AGENCY

A. The Aggregate Pier Installer shall provide full-time Quality Control monitoring of Aggregate Pier construction activities. The General Contractor is responsible for retaining an independent engineering testing firm to provide Quality Assurance services.

6.2 RESPONSIBILITIES OF INDEPENDENT ENGINEERING TESTING AGENCY

A. The Testing Agency shall monitor the modulus test pier installation and testing. The Installer shall provide and install all dial indicators and other measuring devices.

B. The Testing Agency shall monitor the installation of Aggregate Piers to verify that the production installation practices are similar to those used during the installation of the modulus test elements.

C. The Testing Agency shall report any discrepancies to the Installer and General Contractor immediately.

D. The Testing Agency shall observe the excavation, compaction and placement of the foundations as described in Section 7.05. Dynamic Cone Penetration testing may be performed to evaluate the footing bottom condition as determined by the Testing Agency.

PART 7 - RESPONSIBILITIES OF THE GENERAL CONTRACTOR

7.1 SITE PREPARATION AND PROTECTION

A. The General Contractor shall locate and protect underground and aboveground utilities and other structures from damage during installation of the Aggregate Piers.

B. Site grades for aggregate pier installation shall be within 1 foot of the top of footing elevation or finished grade elevation to minimize aggregate pier installation depths. Ground elevations and bottom of footing elevations shall be provided to the Rammed Aggregate Pier Installer in sufficient detail to estimate installation depth elevations to within 3 inches.

C. The General Contractor will provide site access to the Installer, after earthwork in the area has been completed. A working surface shall be established and maintained by the General Contractor to provide wet weather protection of the subgrade and to provide access for efficient operation of the Aggregate Pier installation.

D. Prior to, during and following Aggregate Pier installation, the General Contractor shall provide positive drainage to protect the site from wet weather and surface ponding of water.

E. If spoils are generated by aggregate pier installation, spoil removal from the aggregate pier work area in a timely manner to prevent interruption of aggregate pier installation is required.

7.2 AGGREGATE PIER LAYOUT

A. The location of aggregate pier-supported foundations for this project, including layout of individual aggregate pier elements, shall be marked in the field using survey stakes or similar means at locations shown on the drawings.

7.3 CONTRACTOR'S / OWNER'S INDEPENDENT TESTING AGENCY (OWNER'S QUALITY ASSURANCE)

A. General Contractor is responsible for acquiring an Independent Testing Agency (Quality Assurance) as required. Testing Agency roles are as described in Part 6 of this specification. The Aggregate Pier Installer will provide Quality Control services as described in Part 5 of this specification.

7.4 EXCAVATIONS FOR OBSTRUCTIONS

A. Should any obstruction be encountered during Aggregate Pier installation, the General Contractor shall be responsible for promptly removing such obstruction, or the pier shall be relocated or abandoned. Obstructions include, but are not limited to, boulders, timbers, concrete, bricks, utility lines, etc., which shall prevent placing the piers to the required depth, or shall cause the pier to drift from the required location.

B. Dense natural rock or weathered rock layers shall not be deemed obstructions, and piers may be terminated short of design lengths on such materials.

7.5 UTILITY EXCAVATIONS

A. The General Contractor shall coordinate all excavations made subsequent to Aggregate Pier installations so that excavations do not encroach on the piers as shown in the Aggregate Pier construction drawings. Protection of completed Aggregate Piers is the responsibility of the General Contractor. In the event that utility excavations are required in close proximity to the installed Aggregate Piers, the General Contractor shall contact the Aggregate Pier Designer immediately to develop construction solutions to minimize impacts on the installed Aggregate Pier elements.

7.6 FOOTING BOTTOMS

A. Excavation and surface compaction of all footings shall be the responsibility of the General Contractor.

B. Foundation excavations to expose the tops of Aggregate Piers shall be made in a workman-like manner, and shall be protected until concrete placement, with procedures and equipment best suited to (1) avoid exposure to water, (2) prevent softening of the matrix soil between and around the Aggregate Piers before pouring structural concrete, and (3) achieve direct and firm contact between the dense, undisturbed Aggregate Piers and the concrete footing.

C. All excavations for footing bottoms supported by Aggregate Pier foundations shall be prepared in the following manner by the General Contractor. Recommended procedures for achieving these goals are to:

1. Limit over-excavation below the bottom of the footing to 3-inches (including disturbance from the teeth of the excavation equipment).
2. Compaction of surface soil and top of Aggregate Piers shall be prepared using a motorized impact compactor ("Wacker Packer," "Jumping Jack," or similar). Sled-type

tamping devices shall only be used in granular soils and when approved by the designer. Loose or soft surficial soil over the entire footing bottom shall be recompacted or removed, respectively. The surface of the aggregate pier shall be recompacted prior to completing footing bottom preparation.

3. Place footing concrete immediately after footing excavation is made and approved, preferably the same day as the excavation. Footing concrete must be placed on the same day if the footing is bearing on moisture-sensitive soils. If same day placement of footing concrete is not possible, open excavations shall be protected from surface water accumulation. A lean concrete mud-mat may be used to accomplish this. Other methods must be pre-approved by the Designer.

D. The following criteria shall apply, and a written inspection report sealed by the project Testing Agency shall be furnished to the Installer to confirm:

1. That water has not been allowed to pond in the footing excavation at any time.
2. That all Aggregate Piers designed for each footing have been exposed in the footing excavation.
3. That immediately before footing construction, the tops of Aggregate Piers exposed in each footing excavation have been inspected and recompacted as necessary with mechanical compaction equipment.
4. That no excavations or drilled shafts (elevator, etc) have been made after installation of Aggregate Pier elements within the excavation limits described in the Aggregate Pier construction drawings, without the written approval of the Installer or Designer.

E. E. Failure to provide the above inspection and certification by the Testing Agency, which is beyond the responsibility of the Aggregate Pier Installer, may void any written or implied warranty on the performance of the Aggregate Pier system.

END OF SECTION 024520

SECTION 02513

WATER DISTRIBUTION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Water distribution piping.
2. Water service connections.
3. Valves and Boxes.
4. Fire Hydrants.
5. Master Water Meter.
6. Positive displacement meters.
7. Underground pipe markers.
8. Aboveground pipe markers.
9. Precast concrete vault.
10. Meter Boxes.
11. Pipe Supports and Anchoring.
12. Pile Support Systems.
13. Concrete Encasement and Cradles.
14. Mechanical Join Restraint.
15. Flange Adaptor.
16. Bolt-through Adaptor.
17. Restrained Coupling.
18. Bedding and cover materials.
19. Finishing - Steel.
20. Adjustable Roller Hanger

B. Related Sections:
1. Plans and general provisions of the Contract including General Conditions, and Technical Specifications.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Water Distribution Piping:
1. Basis of Measurement: Linear Foot.
2. Basis of Payment: Includes all labor and equipment associated with excavating (including rock excavation), installation water main at locations shown on Plans, installation of detector wire and tape, bedding, backfill with excavated material, concrete for thrust blocks, mechanical restraints, restrained coupling, compaction, supply and installation of blue pipeline markers as requested by Engineer/Owner, disinfection and testing, cleanup, traffic control, and all related items. Also includes erosion control to the satisfaction of the Engineer if no additional pay items exist. Payment shall be per linear foot of water main laid, based on the size, material, special coating (if required), and joint type shown on the Plans and reflected on the Bid Form.

B. Wet Connection:
   1. Basis of Measurement: Per Each.
   2. Basis of Payment: Includes all labor, material, and equipment associated with excavation (including rock excavation unless otherwise stated), coordination of service outages, isolation of system by closing valves, cutting of existing pipe, dewatering, removal of cut pipe, any necessary piping/fittings to make the connection, bedding, native soil backfill, testing, cleanup, and all related items. Also includes erosion control to the satisfaction of the Engineer if no additional pay items exist.

C. Compact Ductile Iron Fittings:
   1. Basis of Measurement: Per Pounds or Tons as indicated on the Bid Form.
   2. Basis of Payment: Includes all labor, material, and equipment associated with excavation (including rock excavation), installation of ductile iron fittings, installation of transition fittings, "mega-lug" retainer glands, concrete thrust blocks, backfill, compaction, testing, cleanup, and all related items.

D. Master Meters:
   1. Basis of Measurement: Per Each.
   2. Basis of Payment: Includes all labor, material, and equipment associated with excavation, master meter, meter box/vault, testing, backfill, cleanup and all related items.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Society of Mechanical Engineers:
   1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

C. ASTM International:
   1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
   2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. ASTM A242 – Standard Specification for High-Strength Low-Alloy Structural Steel.
   4. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
   5. ASTM A674 – Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water and Other Liquids.
   6. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
   7. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   8. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   9. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

10. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
11. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
12. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
13. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

D. American Water Works Association:
1. ANSI/AWWA C104/A21.4 - Standard for Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. ANSI/AWWA C105/A21.5 - Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. ANSI/AWWA C110/A21.10 - Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm Through 1,219 mm), for Water.
4. ANSI/AWWA C111/A21.11 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. ANSI/AWWA C115/A21.15 - Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
6. ANSI/AWWA C116/A21.16 – Standard for Protective Fusion-bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings.
7. ANSI/AWWA C150/A21.50 - Standard for the Thickness Design of Ductile-Iron Pipe.
8. ANSI/AWWA C151/A21.51 - Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
9. ANSI/AWWA C153/A21.53 - Standard for Ductile-Iron Compact Fittings for Water Service.
10. AWWA C200 - Steel Water Pipe 6 In. (150 mm) and Larger.
11. AWWA C203 - Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
12. AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. and Larger - Shop Applied.
13. AWWA C206 - Field Welding of Steel Water Pipe.
14. AWWA C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
15. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.
16. AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
17. AWWA C300 - Reinforced Concrete Pressure Pipe, Steel-Cylinder Type.
18. AWWA C301 - Prestressed Concrete Pressure Pipe, Steel-Cylinder Type.
19. AWWA C515 – Reduced Wall, Resilient-Seated Gate Valves for Water Supply Service.
20. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
21. AWWA C605 - Water Treatment - Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water.
22. AWWA C606 - Grooved and Shouldered Joints.
23. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
24. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.

25. AWWA C702 - Cold-Water Meters - Compound Type.
26. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
27. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. through 12 In. (100 mm Through 300 mm), for Water Distribution.
28. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 36 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution.
29. AWWA C906 – Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission
30. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

E. Manufacturer's Standardization Society of the Valve and Fittings Industry:
1. MSS SP-60 - Connecting Flange Joint between Tapping Sleeves and Tapping Valves.

F. National Fire Protection Agency:
1. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Shop Drawings: Indicate piping layout, including piping specialties.

C. Product Data: Submit data on pipe materials, pipe fittings, valves and accessories.

D. Manufacturer's Certificates: Submit Statement of Compliance, supporting data, from material suppliers attesting that valves, hydrants, and accessories provided meet or exceed AWWA Standards and specification requirements.

E. Fusion Technician Qualification: HDPE or Fusible PVC pipe manufacturer or pipe supplier qualification to butt-fuse pipe products.

1.5 QUALIFICATIONS

A. Manufacturer: company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.6 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements.

B. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements.

B. Deliver and store materials in shipping containers with labeling in place.

C. Block individual and stockpiled pipe lengths to prevent moving.

D. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.

E. Store polyethylene and PVC materials out of direct sunlight.

F. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

1.8 MAINTENANCE MATERIALS

A. Furnish one valve tee wrench and one fire hydrant wrench to Owner.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION PIPING

A. Ductile Iron Pipe: AWWA C151.
   1. Coatings and Lining:
      a. Outside: Bituminous coating, 1-mil minimum.
         1) Zinc outside coating if indicated in the Plans and/or Bid Form. ISO 8179-1
      b. Inside: Cement-mortar lining with Sealcoat, ANSI/AWWA C104/A21.4.
         1) Cement-mortar, double thickness if indicated in the Plans and/or Bid Form.
   2. Pipe Class: AWWA C151, for nominal thickness, rated water working pressure and maximum depth of cover. Pressure Classification as required on drawings for normal installation. Class 56 for pipe installation on river channel bottom.
   3. Fittings: Ductile iron, AWWA C110. Compact fittings AWWA C153.
      a. Coating and Lining:
         1) Bituminous Coating: AWWA C110.
         2) Cement Mortar Lining: AWWA C104, double thickness.
         3) Fusion-bonded Epoxy if indicated in the Plans and/or Bid Form: AWWA C116.

4. Joints:
    a. Mechanical and Push-On Joints: AWWA C111.
    b. Flanged Joints: AWWA C115.
    c. Restrained Joints: Refer to Section 2.14.
    d. Gaskets: Manufacturer's standard for push-on joint pipe. Refer to Section 2.15.
5. Encasement: AWWA C105 polyethylene encasement, 10 mil minimum thickness.

B. Polyvinyl Chloride (PVC): AWWA C900 and AWWA C905, Pressure Class 200:
1. Fittings: Ductile iron, AWWA C110. Compact fittings AWWA C153.
    a. Coating and Lining:
        1) Bituminous Coating: AWWA C110.
        2) Cement Mortar Lining: AWWA C104, double thickness.
        3) Fusion-bonded Epoxy if indicated in the Plans and/or Bid Form: AWWA C116.
2. Joints:
    a. ASTM D3139 PVC flexible elastomeric seals. Solvent-cement couplings are not permitted.

C. Polyvinyl Chloride (PVC): ASTM D2241, SDR-21 for 200 psig rating:
1. Fittings: Ductile iron, AWWA C110. Compact fittings AWWA C153.
    a. Coating and Lining:
        1) Bituminous Coating: AWWA C110.
        2) Cement Mortar Lining: AWWA C104, double thickness.
        3) Fusion-bonded Epoxy if indicated in the Plans and/or Bid Form: AWWA C116.
2. Joints:
    a. ASTM D3139 PVC flexible elastomeric seals. Solvent-cement couplings are not permitted.
    b. Butt-fusion, per pipe supplier's written instructions and qualified fusion technician.

D. Fusible PVC: Refer to Section 02511

E. High Density Polyethylene (HDPE): Refer to Section 02514

F. Steel Pipe: AWWA C200 Fabricated Pipe, minimum wall thickness 0.375 inches for pipe diameters up to 8 inches and 0.50 inches for pipe diameters greater than 8 inches.
1. Fittings and Special Sections: AWWA C208.
2. Flanges: AWWA C207 slip-on.
3. Field Welding Materials:
    a. Pipe: AWWA C206.
    b. Joints: AWWA C205.
4. Interior Cement Mortar Lining: AWWA C205.
5. Buried Steel Pipe Exterior Lining:
    a. AWWA C213, fusion-bonded epoxy coating.

2.2 WATER SERVICE CONNECTIONS

A. Furnish materials and install in conformance with Section 02515.

2.3 VALVES AND BOXES

A. Furnish materials and install in conformance with Section 02085.

2.4 FIRE HYDRANTS

A. Furnish materials and install in conformance with Section 02088.

2.5 MASTER WATER METER

A. Manufacturers:
   1. Neptune HP Turbine
   2. Badger Meter Turbo Series
   3. Substitutions: Section 01600 – Product Requirements.

B. Water meters: Inline horizontal-axis type. AWWA Class II meeting NSF/ANSI 61 and NSF/ANSI 372 requirements.
   1. Operating flow range: 100% $\pm$ 1.5% based on meter size.
   2. Maximum Operating Temperature: 120° F (49° C).
   3. Accuracy: Within 1.5%
   4. 150 psig maximum working pressure or as reflected on the Plans.
   5. Strainer: Integral or flanged in-line.
   6. Straightening Vane: Directly upstream.
   7. Housing and Head Material: Lead-free allow
   8. Flanges: U.S. ANSI B16.1/AWWA Class 125
   9. Register shall be in gallons unless stated elsewhere.
   10. Encoder: If specified, meter shall be equipped with encoder remote registers per AWWA C707 and meet all AWWA C701 performance standards.
   11. Meter size: As Shown on Plans or the Bid Form.

2.6 POSITIVE DISPLACEMENT METERS

A. Furnish materials and install in conformance with Section 02515.

2.7 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Bright colored, continuously printed with "Water Service" in large letters, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

B. Trace Wire (for non-metallic pipe): No. 12 gauge copper clad steel (CCS) reinforced with blue plastic covering, imprinted.

2.8 ABOVEGROUND PIPE MARKERS

A. Manufacturer:
   1. Markers to Locations: Furnish at valves, casing ends, major bends, and other locations requested by Engineer or Owner.

B. Marker: Install according to manufacturer’s instructions. Color and markings shall be blue unless otherwise indicated.

2.9 PRECAST CONCRETE VAULTS

A. Precast Concrete Vaults: Conform to Section 02086.

2.10 METER BOXES

A. Furnish materials in conformance with Section 02515.

2.11 PIPE SUPPORTS AND ANCHORING

A. Metal for pipe support brackets: Structural steel, thoroughly coated with epoxy paint.

B. Metal tie rods and clamps or lugs: Galvanized steel sized in accordance with NFPA 24.

2.12 PILE SUPPORT SYSTEMS

A. Pipe piers shall be field cast, 4000 psi, 28-day mix, as detailed in the Plans.

B. Timber Piles: Conform to Section 02643.

C. Timber for Cradle: Southern Yellow Pine well-seasoned conforming to Section 06100 and surfaced on all sides with preservative treatment.

D. Preservative Treatment for Timber: Conform to Section 02463.

2.13 CONCRETE ENCASEMENT AND CRADLES

A. Concrete: Conforming to Section 03300, 4,000 psi 28-day reinforced concrete, rough troweled finish.

B. Concrete Reinforcement: Conform to Section 03200.

2.14 STEEL CASING AND TUNNER LINER

A. Refer to Section 02444 – Casing Pipe and Tunnel Liner.

2.15 JOINT RESTRAINT

A. Type I: Mechanical Joint Restraint
   1. Restraint devices for nominal pipe sizes 3" – 36" shall consist of multiple gripping wedges incorporated into a retainer gland meeting the requirements of ANSI/AWWA C111/A21.11, except for HDPE pipe.
   2. The devices shall have a working pressure rating equal to that of the pipe on which it is used. Ratings are for water pressure and must include a minimum safety factor of 2:1 in all sizes.
   3. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron.
   4. Mechanical joint restraint shall be as follows:
      a. Series 2000PV by EBAA Iron, Inc. or equal for connecting PVC to mechanical joint fittings.

b. Series 1100 by EBAA Iron, Inc. or equal for connecting ductile iron pipe to mechanical joint fittings.

5. HDPE shall be fully restrained with fused-on flange adaptors, MJ adaptors, or other approved method or fitting. All recommendations and instructions for fitting from manufacturer shall be followed. No gripper-style restraints will be allowed.
6. HDPE connections shall be longitudinally restrained per the design by restrained fittings, anchor blocks, or other approved method.

B. Type II: Restrained Joint Pipe
1. Restrained Joint Pipe: AWWA C111.
2. Flexible restrained push-on type equivalent to "TR Flex" as manufactured by U.S. Pipe, or "Flex-Ring" as manufactured by American Cast Iron Pipe Company.
3. Restrained Joint Pipe shall be stored, installed, and tested in accordance with manufacturer's instructions.

C. Type III: Restraining Gaskets
1. Restraining Gaskets: ANSI/AWWA C111/A21.11
2. Push on joint pipe specified with restraining gaskets shall incorporate gaskets equivalent to "Field-Lok 350 Gaskets" as manufactured by U.S. Pipe, or "Fast-Grip Gaskets" as manufactured by American Cast Iron Pipe Company.
3. Restraining Gaskets shall not be used at pipe end terminations.
4. Restraining Gaskets shall be stored, installed, and tested in accordance with manufacturer's instructions.

2.16 FLANGE ADAPTOR

A. Flange adaptors may be used in lieu of threaded or welded flanges of plain end ductile pipe where allowed by the Engineer. These shall not be used with HDPE.

B. The restraints shall be manufactured of ductile iron conforming to ASTM A536.

C. The bolt circles and bolt holes shall conform to ANSI/AWWA C110/A21.10.

D. The restraint shall be Series 1000-EZ Flange as manufactured by EBAA Iron, Inc. or equal.

2.17 BOLT-THROUGH ADAPTOR

A. A bolt-through mechanical adaptor may be used or required in lieu of standard flange adaptors. These shall not be used with HDPE.

B. The restraints shall be manufactured of ductile iron conforming to ASTM A536.

C. The bolt circles and bolt holes shall conform to ANSI/AWWA C110/A21.11 and ASTM A242.

D. The adaptor shall be the "Foster" adaptor as manufactured by Infact Corporation or equal.

2.18 RESTRAINED COUPLING

A. Restrained couplings are used for joining and restraining two plain end pipes of the same or dissimilar materials.

B. Coupling shall be capable of being used on ductile iron, steel, PVC or HDPE pipe.

C. Coupling shall be constructed of ASTM A536 ductile iron and designed with a 2:1 safety factor.

D. Internal pipe wall stiffeners must be used when restraining HDPE.

E. The restraint mechanism shall incorporate a plurality of individually actuating gripping surfaces to maximize restraint capability and have torque limiting twist off nuts to insure proper actuating of the restraint devices.

F. The restraint devices shall be coated using fusion bonded epoxy approved for potable water contact.

G. The coupling sleeve internal surface (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61.

H. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

I. The restrained joining system shall meet the applicable requirements of AWWA C219, ANSI/AWWA C111/A21.11, and ASTM D2000.

J. The restrained coupling system shall be Series 3800 manufactured by EBAA Iron, Inc. or and approved equal.

2.19 BEDDING AND COVER MATERIALS

A. Bedding: Fill Type A2 as specified in Section 02060.

B. Cover: Fill Type as specified in Section 02300 and the Plans.

C. Soil Backfill from Above Pipe to Finish Grade: Soil as specified in Section 02300.

2.20 ACCESSORIES

A. Concrete for Thrust Restraints: Conform to Section 03300.

B. Steel rods, bolts, lugs and brackets: ASTM A36/A36M or ASTM A307 carbon steel.

C. Protective Coating: Bituminous coating.

2.21 FINISHING - STEEL

A. Galvanizing: ASTM A123/A123M; minimum 2.0 oz/sq ft coating thickness; galvanize after fabrication.

2.22 ADJUSTABLE ROLLER HANGER

A. Material: carbon steel axle with cast iron roller and socket ends.

B. Finish: electro-galvanized.

C. Service: designed for the suspension of pipe where longitudinal movement may occur due to expansion/contraction. Vertical adjustment is required.

D. Rods shall be installed into existing concrete bridge deck according to manufacturer's recommendations. Wedge type or epoxy type anchors shall be used to attach the rods to the bridge deck. Anchors shall be capable of supporting four (4) times the dead load of the pipe plus the water.

E. Each hanger shall have a lower and upper roller, fully adjustable.

F. Manufacturer:
1. Empire Industries, Inc.
2. Cooper B-Line
3. National Pipe Hanger Corporation
4. Substitutions: Section 01600 – Product Requirements

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Verify existing utility water main size, location, and type is as indicated in the Plans.

C. Determine exact location and size of valves and hydrants from the Plans; obtain clarification and directions from Engineer prior to execution of work.

D. Verify invert elevations of existing work prior to excavation and installation of valves and fire hydrants.

E. All pipe and fittings must be inspected for damage from prior to installation. Any damaged piping must be replaced prior to installation.

3.2 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe material being cut. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare pipe connections to equipment with flanges or unions.

D. Do not interrupt existing utilities without permission and without arranging to provide temporary utility services.
   1. Notify Owner and Engineer not less than two days in advance of proposed utility interruption.

3.3 BEDDING

A. Excavate pipe trench in accordance with Section 02300 for Work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated in the Plans.

B. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.

C. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8 inches compacted depth; compact to 95 percent.

3.4 INSTALLATION - PIPE

A. Install pipe in accordance with AWWA C600. Trenching shall be in accordance with Section 02324. Directional boring shall be in accordance with Section 02448.

B. Handle and assemble pipe in accordance with manufacturer's instructions and as indicated in the Plans.

C. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.

D. Maintain a minimum of 5 feet horizontal separation of water main from sewer piping.

E. Install ductile iron piping and fittings to AWWA C600.

F. Weld pipe in accordance with AWWA C206. Weld joints in accordance with AWWA C205.

G. Flanged Joints: Not to be used in underground installations except within structures.

H. Route pipe in straight line. Relay pipe that is out of alignment or grade.

I. Install pipe with no high points. If unforeseen field conditions arise which necessitate high points, install air release valves as directed by Engineer.

J. Install pipe to have bearing along entire length of pipe. Excavate bell holes to permit proper joint installation. Do not lay pipe in wet or frozen trench.

K. Prevent foreign material from entering pipe during placement.

L. Install pipe to allow for expansion and contraction without stressing pipe or joints.

M. Close pipe openings with watertight plugs during work stoppages.

N. Install access fittings to permit disinfection of water system performed under Section 02516.

O. Establish elevations of buried piping with not less than three feet of cover. Measure depth of cover from final surface grade to top of pipe barrel.

P. Install plastic ribbon tape continuous 12 inches below final grade of surface.

Q. Install trace wire continuous 12 inches above any non-metallic pipe.

3.5 POLYETHYLENE ENCASEMENT

A. Encase piping in polyethylene where indicated on the Plans to prevent contact with surrounding backfill material or concrete thrust blocks.

B. Install in accordance with AWWA C105 and ASTM A674.

C. Terminate encasement 3 to 6 inches above ground where pipe is exposed.

3.6 THRUST RESTRAINT

A. Provide valves, tees, bends, caps, and plugs with concrete thrust blocks, Type I, II, or III restraint as indicated in the Plans. For concrete thrust blocks, pour against undisturbed earth. Locate thrust blocks such that pipe and fitting joints will be accessible for repair.

B. Install tie rods, clamps, set screw retainer glands, concrete anchors or restrained joints as indicated in the Plans. Protect metal restrained joint components against corrosion, when in contact with concrete, by applying a bituminous coating, or by concrete mortar encasement of metal area. Do not encase pipe and fitting joints to flanges.

C. Install thrust blocks, tie rods, and type I or II joint restraint at dead ends of water main as shown in the Plans.

3.7 SERVICE CONNECTIONS

A. Install service connections in accordance with Section 02515.

3.8 BACKFILLING

A. Backfill around sides and to top of pipe with cover fill in maximum lifts of 6 inches, tamp in place and compact in accordance with the Plans and Specifications. Place and compact material immediately adjacent to pipes to avoid damage to pipe and prevent pipe misalignment.

B. Maintain optimum moisture content of bedding material to attain required compaction density.

3.9 DISINFECTION OF POTABLE WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 02516.

3.10 FIELD QUALITY CONTROL

A. Refer to Section 02514 for pressure test requirements for high density polyethylene (HDPE) piping.

B. In piping systems with multiple material types, HDPE piping must be pressure tested separately from ductile iron and/or PVC piping, unless otherwise indicated by the Engineer. Following an approved test for HDPE piping, the connections can be made, and the entire system can be tested as described below.

C. Pressure test system to the greater of 1.25 times the working pressure at the highest point in the test segment or 1.5 times the working pressure at the point of testing, not to exceed the pipeline or valve pressure rating in the test segment. Repair leaks and re-test.

1. After completion of pipeline installation, including backfill, but prior to final connection to existing system, conduct, in presence of Engineer, concurrent hydrostatic pressure and leakage tests in accordance with AWWA C600.
2. Provide all equipment required to perform leakage and hydrostatic pressure tests including water storage means, acceptable water volume measurement means, pumps, piping, calibrated pressure gauges, and chart recorder. Upon request of Engineer, provide certification of calibration of equipment acceptable to Engineer.
3. Test Pressure: The greater of 1.25 times the working pressure at the highest point in the test segment or 1.5 times the working pressure at the point of testing, not to exceed the pipeline or valve pressure rating in the test segment. Obtain working pressure from Engineer.
4. Conduct hydrostatic test for at least six-hour duration.
5. Before applying test pressure, completely expel air from section of piping under test. Provide corporation cocks so air can be expelled as pipeline is filled with water. After air has been expelled, apply test pressure. At conclusion of tests, close and permanently seal resulting piping openings.
6. Slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.
7. Examine exposed piping, fittings, valves, hydrants, and joints carefully during hydrostatic pressure test. Repair or replace damage or defective pipe, fittings, valves, hydrants, or joints discovered, following pressure test.
8. Maintain test pressure within +/- 5 psi throughout test duration by pumping additional water into the test segment. Accurately record test segment pressure continuously on chart recorder and volume of additional water supplied to test segment. Additional water supplied shall be designated as the leakage.
9. No pipeline installation will be approved when leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{C}$$

L = allowable, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of pipe, in inches

p= average test pressure during leakage test, in pounds per square inch gauge
C = 133,200

10. When leakage exceeds specified acceptable rate, locate source and make repairs. Repeat test until specified leakage requirements are met.

END OF SECTION

SECTION 02536

FORCE MAINS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Force mains.
   2. Bedding and cover materials.

B. Related Sections:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Pipe and Fittings:
   1. Basis of Measurement: By linear foot.
   2. Basis of Payment: Includes hand trimming excavation, backfill, bedding, thrust restraints, pipe, and fittings.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:
   1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
   2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   3. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   4. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
   5. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   6. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   7. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   8. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. American Water Works Association:
   1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
   2. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
   3. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   4. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

D. Ductile Iron Pipe Research Association:
   1. DIPRA Section 1X, Thrust Restraint.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Submit shop drawings for ductile iron pipe. Indicate piece numbers and locations and restrained joint locations.

C. Product Data: Submit data indicating pipe material used, pipe accessories, restrained joint details and materials.

D. Design Data: Submit restrained joint design data and calculations for ductile iron pipe establishing lengths of restrained joint piping required.

E. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Record location of pipe runs, connections, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

A. Design ductile iron pipe restrained joints in accordance with DIPRA Section 1X Standards.

1.7 PRE-INSTALLATION MEETINGS – **Not Required**

A. Section 01300 - Administrative Requirements.

B. Convene minimum one week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

A. Verify field measurements and elevations are as indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements.

B. Do not place materials on private property without written permission of property owner.

C. During loading, transporting and unloading, exercise care to prevent damage to materials.

D. Do not drop pipe or fittings.

E. Avoid shock or damage to pipe.

F. Take measures to prevent damage to exterior surface or internal lining of pipe.

G. Do not stack pipe higher than recommended by pipe manufacturer.

H. Store gaskets for mechanical and push-on joints in cool, dry location out of direct sunlight and not in contact with petroleum products.

1.10 COORDINATION

A. Section 01300 - Administrative Requirements.

B. Coordinate the Work of connection to existing sewer force mains, manholes, or other facilities with Owner.

PART 2 PRODUCTS

2.1 FORCE MAIN

A. Ductile Iron Pipe: AWWA C151; standard cement mortar lining (AWWA C104) or Ceramic Epoxy lining (Protecto 401), outside coated.
   1. Pipe - 3 Inches to 12 Inches: Pressure Class - 350 psi.
   2. Pipe - 14 Inches to 24 Inches: Pressure Class - 250 psi.
   3. Pipe - 30 Inches to 48 Inches: Pressure Class - 150 psi.

B. Ductile Iron Fittings:
   1. AWWA C110; - 350 psi pressure rating.
   2. Fitting to be cement mortar or ceramic epoxy lined and outside coated as for ductile iron pipe.

C. Joints: AWWA C111, where not specifically indicated on Drawings.
   1. Type: Mechanical joint or push-on joint.

D. Rubber Gaskets, Lubricants, Glands, Bolts and Nuts: AWWA C111.

2.2 POLYVINYL CHLORIDE (PVC) PIPE

A. PVC Pressure Sewer Pipe and Fittings - 12" Nominal Pipe Size and Smaller:
   1. ASTM D2241, PVC 1120; SDR 26.

2.3 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

B. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Sewage Force Main" in large letters.

2.4 BEDDING AND COVER MATERIALS

A. Bedding: Fill Type A2 as specified in Section 02060.

B. Cover: As specified in Section 02300.

C. Soil Backfill from Above Pipe to Finish Grade: As specified in Section 02300.

2.5 CONCRETE

A. Concrete in accordance with Section 03300.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Verify project is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Correct over excavation with coarse aggregate.

B. Remove large stones or other hard matter capable of damaging pipe or impeding consistent backfilling or compaction.

3.3 BEDDING

A. Excavate pipe trench in accordance with Section 02300.

B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches.

3.4 INSTALLATION - PIPE

A. Install pipe, fittings, and accessories in accordance with Drawings.

B. Route piping in straight line.

C. Refer to Section 02300 for backfilling and compacting requirements. Do not displace or damage pipe when compacting.

D. Connect to municipal sewer system as shown on the Drawings.

E. Install detectable underground utility marking tape continuous over top of pipe.

3.5 INSTALLATION - THRUST RESTRAINT

A. Provide pressure pipeline with restrained joints or concrete thrust blocking at bends, tees, and changes in direction; construct concrete thrust blocking in accordance with Drawings.

3.6 INSTALLATION - CRADLES AND ENCASEMENT

A. Provide concrete cradles and encasement for pipeline where indicated on Drawings as specified in Section 03300.

3.7 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements, 01700 - Execution Requirements.

B. Pressure test system to the greater of 1.25 times the working pressure at the highest point in the test segment or 1.5 times the working pressure at the point of testing, not to exceed the pipeline or valve pressure rating in the test segment. Repair leaks and re-test.
   1. After completion of pipeline installation, including backfill, but prior to final connection to existing system, conduct, in presence of Engineer, concurrent hydrostatic pressure and leakage tests in accordance with AWWA C600.
   2. Provide all equipment required to perform leakage and hydrostatic pressure tests including water storage means, acceptable water volume measurement means, pumps, piping, calibrated pressure gauges, and chart recorder. Upon request of Engineer, provide certification of calibration of equipment acceptable to Engineer.
   3. Test Pressure: The greater of 1.25 times the working pressure at the highest point in the test segment or 1.5 times the working pressure at the point of testing, not to exceed the pipeline or valve pressure rating in the test segment. Obtain working pressure from Engineer.
   4. Conduct hydrostatic test for at least six-hour duration.
   5. Before applying test pressure, completely expel air from section of piping under test. Provide corporation cocks so air can be expelled as pipeline is filled with water. After air has been expelled, apply test pressure. At conclusion of tests, close and permanently seal resulting piping openings.

6. Slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.
7. Examine exposed piping, fittings, valves, hydrants, and joints carefully during hydrostatic pressure test. Repair or replace damage or defective pipe, fittings, valves, hydrants, or joints discovered, following pressure test.
8. Maintain test pressure within +/- 5 psi of specified test by pumping additional water in to the test segment. Accurately record test segment pressure continuously on chart recorder and volume of additional water supplied to test segment. Additional water supplied shall be designated as the leakage.
9. No pipeline installation will be approved when leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{C}$$

L = allowable, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of pipe, in inches
p = average test pressure during leakage test, in pounds per square inch gauge
C = 133,200

10. When leakage exceeds specified acceptable rate, locate source and make repairs. Repeat test until specified leakage requirements are met.

C. Request inspection prior to and immediately after placing bedding.

D. When tests indicate Work does not meet specified requirements, remove work, replace and retest.

3.8 PROTECTION OF FINISHED WORK

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 02539

SANITARY SEWER SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sanitary sewer pipe and fittings.
   2. Connection to existing manholes.
   3. Manholes.
   4. Wye branches and tees.
   5. Sanitary Laterals.

B. Related Sections:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:
   1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
   2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
   4. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
   5. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
   6. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
   7. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
   8. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
   9. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
   10. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   11. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   12. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

13. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
14. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
15. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
16. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
17. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
18. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
19. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
20. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
21. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
22. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. American Water Works Association:
1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
4. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C150 - ANSI Standard for the Thickness Design of Ductile Iron Pipe.
6. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
7. AWWA C153 - American National Standard for Ductile-Iron Compact Fittings for Water Service.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Product Data: Submit catalog cuts and other pertinent data indicating proposed materials, accessories, details, and construction information.

C. Submit reports indicating field tests made and results obtained.

D. Manufacturer's Installation Instructions:
1. Indicate special procedures required to install Products specified.
2. Submit detailed description of procedures for directional drilling installation.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Alabama Department of Environmental Management standard.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum years documented experience.

1.7 PRE-INSTALLATION MEETINGS – **Not Required**

A. Section 01300 - Administrative Requirements.

B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements.

B. Deliver and store valves in shipping containers with labeling in place.

C. Block individual and stockpiled pipe lengths to prevent moving.

1.9 FIELD MEASUREMENTS

A. Verify field measurements and elevations are as indicated.

1.10 COORDINATION

A. Section 01300 - Administrative Requirements.

B. Coordinate the Work with Owner and Public Works Department.

C. Notify affected utility companies minimum of 72 hours prior to construction.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPE AND FITTINGS

A. Ductile Iron Pipe: AWWA C150, AWWA C151 and ASTM A746, Class 50 or above, bell and spigot ends.
   1. Manufacturers:
      a. U.S. Pipe and Foundry.
      b. American Cast Iron Pipe Company.
      c. McWane, Inc.
      d. Substitutions: Section 01600 - Product Requirements.
   2. Outside Coating: AWWA C151, asphaltic coating, 1 mil uniform thickness.
   3. Lining: Cement mortar lined in accordance with AWWA C104 or Ceramic Epoxy Lining (Protecto 401).
   4. Polyethylene encasement: AWWA C105. **(Not Used)**
   5. Fittings: AWWA C153 or AWWA C110, ductile iron, Class 50 or above, cement mortar lined in accordance with AWWA C104.
   6. Mechanical Joints: AWWA C111, rubber gasket joint devices.

B. Plastic Pipe: ASTM D3034, Type PSM, Poly (Vinyl Chloride) (PVC) material; bell and spigot style rubber ring sealed gasket joint.
   1. Standard Dimension Ratio: 26
   2. Fittings: ASTM D-2321, PVC.
   3. Joints: ASTM F477, elastomeric gaskets.

C. High Density Polyethylene Pipe: ASTM D3350
   1. Manufactured from materials conforming to the requirements of PE 3408 meeting cell classification 345464E for striped pipe.
   2. Sizes 1-1/4" – 3": AWWA C901-96 and ASTM D3035.
   3. Sizes 4" IPS and larger: ASTM F714 and AWWA 906-99.
   4. Fittings: ASTM D 3261 and AWWA 906-99.
   5. All polyethylene pipe and fittings shall be DR 11 (Pressure class 160 PVC equivalent).
   6. All pipes shall be black in color with a green stripe indicating sanitary sewer pipe.

D. Ribbed Plastic Pipe: ASTM F794, bell and spigot style joint.
   1. Interior: Smooth.
   2. Exterior Ribs: Perpendicular to pipe axis
   3. Pipe Stiffness: 60 psi for 8"-12" pipe
      46 psi for 15"-30" pipe.

2.2 MANHOLES

A. Manholes: As specified in Section 02082; precast concrete, 48 inch diameter, eccentric conical top, cast iron frames and covers, cover inscribed with SANITARY SEWER."

2.3 BEDDING AND COVER MATERIALS

A. Bedding: Fill Type A2, as specified in Section 02060.

B. Cover: Fill to top of pipe with Type A2 aggregate, as specified in Section 02060.

C. Soil Backfill from top of pipe to Finish Grade: Soil with no rocks over 6 inches in diameter, frozen earth or foreign matter. See Section 02300.

D. If pipe is under a paved surface, it is to be backfilled entirely with Type A2 aggregate.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Verify trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.2 PREPARATION

A. Correct over excavation with coarse aggregate.

B. Remove large stones or other hard matter capable of damaging pipe or impeding consistent backfilling or compaction.

C. Protect and support existing sewer lines, utilities and appurtenances.

D. Maintain profiles of utilities. Coordinate with other utilities to eliminate interference. Notify Engineer where crossing conflicts occur.

3.3 BEDDING

A. Excavate pipe trench in accordance with Section 02324.

B. Excavate to lines and grades shown on Drawings or required to accommodate installation of encasement.

C. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.

D. Provide sheeting and shoring in accordance with Section 02324.

E. Place bedding material at trench bottom, level materials in continuous layer not exceeding 8 inches compacted depth; compact to 90 percent.

3.4 INSTALLATION - PIPE

A. Install pipe, fittings, and accessories in accordance with ASTM D2321. Seal joints watertight.

B. Lay pipe to slope gradients noted on drawings; with maximum variation from indicated slope of 1/8 inch in 20 feet. Begin at downstream end and progress upstream.

C. Assemble and handle pipe in accordance with manufacturer's instructions except as modified on the Drawings or by Engineer.

D. Keep pipe and fittings clean until work is completed and accepted by Engineer. Cap open ends during periods of work stoppage.

E. Lay bell and spigot pipe with bells upstream.

F. Polyethylene Pipe Encasement: AWWA C105.

3.5 INSTALLATION - CONNECTION TO EXISTING MANHOLE

A. Core drill existing manhole to clean opening. Using pneumatic hammers, chipping guns, sledge hammers, is not permitted.

B. Install watertight Link-Seal type gasket and seal with non-shrink concrete grout.

C. Prevent construction debris from entering existing sewer line when making connection.

3.6 INSTALLATION - MANHOLES

A. Install manholes in accordance with Section 02082.

3.7 INSTALLATION - WYE BRANCHES AND TEES

A. Install wye branches or pipe tees at locations indicated on Drawings concurrent with pipe laying operations. Use standard fittings of same material and joint type as sewer main.

B. Maintain minimum 5 feet separation distance between wye connection and manhole.

C. Use saddle wye or tee with stainless steel clamps for taps into existing piping. Mount saddles with solvent cement or gasket and secure with metal bands. Layout holes with template and cut holes with mechanical cutter.

3.8 INSTALLATION - SANITARY LATERALS

A. Construct laterals from wye branch to terminal point at right-of-way.

B. Where depth of main pipeline warrants, construct riser type laterals from wye branch.

C. Maintain 2 feet minimum depth of cover over pipe.

D. Maintain minimum 5 feet separation distance between laterals.

E. Install cleanout and watertight plug, braced to withstand pipeline test pressure thrust, at termination of lateral. Install temporary marker stake extending from end of lateral to 12 inches above finished grade. Paint top 6 inches of stake with fluorescent orange paint.

3.9 BACKFILLING

A. Backfill around sides and to top of pipe in accordance with Section 02300.

B. Maintain optimum moisture content of bedding material to attain required compaction density.

3.10 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements.

B. Pressure Test: Test in accordance with Section 02952.

C. Infiltration Test: Test in accordance with Section 02952.

D. Deflection Test: Test in accordance with Section 02952.

E. Request inspection prior to placing bedding.

F. When tests indicate Work does not meet specified requirements, remove work, replace and retest.

3.11 PROTECTION OF FINISHED WORK

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 02923

LANDSCAPE GRADING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Final grade topsoil for finish landscaping.

B. Related Sections:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Samples: When requested by the Engineer, submit, in air-tight containers, 5 lb sample of each type of fill to testing laboratory.

C. Materials Source: Submit name of imported materials source.

1.3 QUALITY ASSURANCE

A. Furnish each topsoil material from single source throughout the Work.

PART 2 PRODUCTS

2.1 MATERIAL

A. Topsoil: Fill type as specified in Section 02300.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Verify building and trench backfilling have been inspected.

C. Verify substrate base has been contoured and compacted.

3.2 PREPARATION

A. Protect landscaping and other features remaining as final Work.

B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

3.3 SUBSTRATE PREPARATION

A. Eliminate uneven areas and low spots.

B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove contaminated subsoil.

C. Scarify surface to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.4 PLACING TOPSOIL

A. Place topsoil in areas where seeding, sodding, and planting, is required to nominal depth of 4 inches. Place topsoil during dry weather.

B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.

C. Remove roots, weeds, rocks, and foreign material while spreading.

D. Manually spread topsoil close to plant material, building, and trees to prevent damage.

E. Remove surplus subsoil and topsoil from site.

F. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.5 TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Top of Topsoil: Plus or minus 1/2 inch.

3.6 PROTECTION OF INSTALLED WORK

A. Section 01700 - Execution Requirements.

B. Prohibit construction traffic over topsoil.

END OF SECTION

SECTION 02926

SEEDING AND SODDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Preparation of subsoil
2. Placing topsoil
3. Fertilizing
4. Seeding
5. Laying Sod
6. Hydroseeding
7. Mulching
8. Soil testing and fertilizer
9. Maintenance

B. Related Sections:
1. Plans and general provisions of the Contract including General Conditions and Technical Specifications.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Grassing and Restoration:
1. Basis of Measurement: Lump Sum or Per Acre.
2. Basis of Payment: Includes all labor, material, and equipment required to finish grading to smooth surface, applying topsoil in 4" minimum thickness, either saved from initial stripping operations, or provided from offsite locations, applying fertilizer, seeding of all areas disturbed by the construction activities, applying mulch to seeded areas, watering, and maintenance of disturbed areas until stand of grass acceptable to Engineer and/or Owner is established.

B. Solid Sodding:
1. Basis of Measurement: Square Yard.
2. Basis of Payment: Includes all labor, material, and equipment required to finish grading to smooth surface, applying topsoil in 4" minimum thickness, either saved from initial stripping operations, or provided from offsite locations, placing solid sodding in locations reflected on the Plans or as directed by the Owner or Engineer, soil amendments, rolling, watering, and maintenance of sod until its rooting is acceptable to Engineer and/or Owner.

1.3 REFERENCES

A. ASTM International:
1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

B. Turfgrass Producers International:
   1. TPI - Guideline Specifications to Turfgrass Sodding.

C. Alabama Department of Transportation (ALDOT) Standard Specifications for Highway Construction (SSHC), Latest Edition:
   1. Section 652 - Ground Preparation, Vegetation Establishment and Mowing
   2. Section 654 – Solid Sodding
   3. Section 860 - Roadside Improvement Materials

1.4 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.5 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Product Data:
   1. Submit data for seed mix, fertilizer, mulch, and other accessories.
   2. Submit data for sod grass species, fertilizer, mulch, and other accessories.

1.6 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements.

B. Operation and Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.7 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

B. Provide sod capable of supporting its own weight without tearing when suspended vertically by holding upper two corners. Sod must be alive or dormant when placed.

1.8 QUALIFICATIONS

A. Seed Supplier: Company specializing in manufacturing Products specified in this section with minimum five years of experience.

B. Sod Producer: Company specializing in manufacturing Products specified in this section with minimum five years of experience.

C. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements.

B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

C. Deliver sod on pallets. Protect roots from dehydration.

D. Do not deliver more sod than can be laid within 48 hours.

E. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.10 COORDINATION

A. Section 01300 - Administrative Requirements.

B. Coordinate with installation of underground sprinkler system piping and watering heads.

1.11 MAINTENANCE SERVICE

A. Section 01700 - Execution Requirements.

B. Maintain seeded and/or sodded areas immediately after placement until grass is well established and exhibits vigorous growing condition.

PART 2 PRODUCTS

2.1 SEED PLANTING SCHEDULE

A. Established lawns and residential areas shall utilize the following schedule:

RATE – (LB/ACRE)	FROM	TO	SEED
30	March 1	May 1	Kentucky 31
20	April 1	August 1	Common Bermuda
30	August 1	November 1	Kentucky 31 Fescue and Unhulled Bermuda
20	November 1	March 1	Annual Rye

B. Unimproved areas may utilize the following schedule:

Planting Dates	March 1 to May 15	May 16 to August 1	March 1 to May 15	Sept. 1 to Nov. 15
Hulled Bermuda Grass	15	20	10	-
Unhulled Bermuda	10	-	10	-
Tall Fescue	-	-	50	50
Annual Lespedeza	-	30	-	-
Reseed Crimson Clover	-	-	30	-

2.2 SOD

A. Reference Section 654 of the ALDOT SSHC, Latest Edition.

2.3 SOIL MATERIALS

A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0. May be excavated from site or from offsite locations.

2.4 ACCESSORIES

A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

B. Fertilizer: Commercial grade; recommended for type of grass used; of proportion necessary to eliminate deficiencies of topsoil to the following proportions: Nitrogen 13 percent, phosphoric acid 13 percent, soluble potash 13 percent.

C. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

D. Erosion Fabric: SC150 BN by North American Green or Equal,
1. 70% straw, 30% coconut fiber mat.
2. Longevity: up to 18 months.
3. Blanket covered top and bottom with 100% biodegradable woven natural fiber netting.
4. Shall meet type 3.8 Specification of Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17.

E. Stakes/Pegs: Softwood lumber, chisel pointed. Of sufficient size and length to anchor sod on slopes.

F. String: Inorganic fiber.

G. Plastic Mesh: Interwoven hexagonal plastic mesh of 2-inch size.

H. Edging: Painted steel.

2.5 HARVESTING SOD

A. Reference Section 654 of the ALDOT SSHC, Latest Edition.

2.6 SOURCE QUALITY CONTROL

A. Section 01400 – Quality Requirements

B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH values.

C. Provide recommendation for fertilizer and lime application rates for specified seed or sod species.

D. Testing is not required when recent tests are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Verify prepared soil base is ready to receive the Work of this section.

3.2 PREPARATION OF SUBSOIL

A. Prepare sub-soil to eliminate uneven areas and low spots.

B. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

C. Remove foreign materials, weeds and undesirable plants and their roots.

D. Remove contaminated subsoil.

E. Scarify subsoil to depth of 4 inches where topsoil is to be placed.

F. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

3.3 PLACING TOPSOIL

A. Spread topsoil to minimum depth of 4 inches over area to be seeded. Rake until smooth.

B. Place topsoil during dry weather and on dry unfrozen subgrade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

E. Install edging at periphery of seeded and/or sodded areas in straight lines to consistent depth.

3.4 FERTILIZING

A. Apply fertilizer at application rate recommended by soil analysis.

B. Apply after smooth raking of topsoil and prior to roller compaction.

C. Do not apply fertilizer at same time or with same machine used to apply seed.

D. Mix fertilizer thoroughly into upper 2 inches of topsoil.

E. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.5 SEEDING

A. Apply seed at rate of 5.5 lbs per 1000 sq ft evenly in two intersecting directions. Rake in lightly.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.

D. Immediately following seeding, apply mulch to thickness of 1/4 inches. Maintain clear of shrubs and trees.

E. Apply water with fine spray immediately after each area has been mulched. Saturate top 4 inches of soil.

3.6 LAYING SOD

A. Moisten prepared surface immediately prior to laying sod.

B. Lay sod within 48 hours after harvesting to prevent deterioration.

C. Lay sod tight with no open joints and no overlapping. Stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.

D. Lay smooth. Align with adjoining grass areas.

E. Place top elevation of sod ½ inch below adjoining paving and/or curbs.

F. On slopes 6 inches per foot and steeper, lay sod perpendicular to slope and secure every row with wooded pegs at a maximum 3 feet on center. When using “big roll”, lay sod parallel to slope. Drive pegs flush with soil portion of sod.

G. Do not place sod when temperature is lower than 40 degrees F.

H. Prior to placing sod, on slopes exceeding 8 inches per foot or where indicated on Drawings, place mesh over topsoil. Securely anchor wire mesh in place with wood pegs sunk firmly into ground.

I. Water sodded areas immediately after installation. Saturate sod to 4 inches of soil.

J. After sod and soil have dried, roll sodded areas to bond sod to soil and to remove minor depressions and irregularities.

3.7 MAINTENANCE OF SOD

A. Mow grass at regular intervals to maintain a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at each mowing.

B. Neatly trim edges and hand clip where necessary.

C. Immediately remove clippings after mowing and trimming.

D. Water to prevent grass and soil from drying out.

E. Roll surface of sod to prevent irregularities.

F. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.

G. Immediately replace sod or re-seed areas showing deterioration or bare spots.

H. Protect sodded areas with warning signs or tape during maintenance period.

3.8 HYDROSEEDING

A. Apply fertilizer, mulch and seeded slurry with hydraulic seeder at rate established by manufacturer.

B. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

3.9 SEED PROTECTION

A. Cover seeded slopes where grade is 3:1 or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

B. Lay fabric smoothly on surface, bury top end of each section in 6-inch-deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.

C. Secure outside edges and overlaps at 36-inch intervals with stakes.

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

END OF SECTION

SECTION 02950

MAINTAINING WASTEWATER FLOW

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Maintaining flow in sanitary sewers.

B. Related Sections:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Submit equipment proposed for bypass pumping to Owner and Engineer for approval. Submit written plan outlining provisions and precautions to be taken to adequately route wastewater flow around the work area and prevent overflow or other spillage of wastewater.

C. Submit data on equipment showing flow capacities and heads for pumps; capacities and number of tanker trucks; lengths, sizes and materials of hoses and sizes and materials of plugs. List all equipment available for bypass pumping.

D. Submit written back-up plan for maintaining wastewater flow should primary equipment fail.

1.3 PRE-INSTALLATION MEETINGS

A. Section 01300 - Administrative Requirements: Pre-installation meeting.

B. Demonstrate ability of equipment to adequately bypass flow without back-ups or surcharging.

1.4 COORDINATION

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Notify Owner and Engineer not less than 48 hours prior to commencing work where wastewater flow control or bypass pumping will be required.

C. Coordinate work with users connected to system.

D. Notify homeowners and businesses at least twenty-four hours in advance of expected disruption of sanitary service.

PART 2 PRODUCTS

2.1 PUMPS

A. Fully automatic self-priming units which do not require the use of foot-valves or vacuum pumps in the priming system.

B. Provide pumps with automatic start/stop controls and discharge piping adequate to prevent spillage of wastewater.

C. Provide sufficient engine silencers to limit noise where diesel units are utilized.

D. Provide pumping system with on-line back-up pump isolated from primary system by valve.

E. Pumping System capable of operating 24 hours per day and capable of running dry for long periods of time.

2.2 PLUGS

A. Restrained inflatable type pneumatic plugs capable of releasing wastewater back-up slowly without surges.

2.3 HOSES

A. Hoses of suitable material for laying on the ground and capable of being run over by vehicular traffic without breaking. Provide hoses free from pinholes or other means of leakage.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify pumping system is adequate to convey peak and wet-weather sewer flow rates without back-ups or surcharging.

C. Verify downstream sewers have adequate capacity to handle by-passed wastewater flow without back-ups, surcharges or overflows.

3.2 DEPTH OF FLOW

A. Control depth of flow in upstream sewer using by-pass pumping to the following depths whenever the following work is occurring.

Maximum Depth of Flow as Percentage of Pipe Diameter					
Television Inspection		**Joint Testing and Sealing**		**Pipe Lining**	
Pipe Diameter	**Max. % Depth of Flow**	**Pipe Diameter**	**Max. % Depth of Flow**	**Pipe Diameter**	**Max. % Depth of Flow**
6-10 inch	20%	6-12 inch	25%	6-10 inch	20%
12-24 inch	25%	15-24 inch	30%	12-24 inch	25%
Larger than 27 inch	30%	Larger than 27 inch	35%	Larger than 27 inch	30%

3.3 BYPASS PUMPING

A. Submit a specific detailed description of proposed bypass pumping system to include written description of plan and addressing quantity, capacity, and location of pumping equipment. Submit spill plan to address any spills that might occur.

B. Plug outgoing side of manhole upstream from work area and bypass pump wastewater from plugged manhole to manhole downstream of work area. Do not allow wastewater to surcharge in plugged manhole or back-up into upstream sewer.

C. If no adequate downstream sewer is available, provide tanker trucks of sufficient number and capacity to haul wastewater to location approved by Owner.

D. Place equipment in location suitable to permit traffic flow and access to homes and business.

E. Route hose through trenches backfilled with crushed aggregate base materials where hoses must cross streets. Do not route hoses through storm drainage pipes or drainage ditches.

F. Protect public and private property water resources, wetlands and other natural resources from damage from spills or back-ups.

G. Pay all clean-up costs and/or fines incurred by Owner on account of wastewater overflows or back-ups caused by operation of the bypass pumping system.

H. Notify Owner and Engineer immediately of leaks or spills and implement emergency containment procedures.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Reinforcing bars.
   2. Welded wire fabric.
   3. Reinforcement accessories.

B. Related Sections:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 REFERENCES

A. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 318 - Building Code Requirements for Structural Concrete.
   3. ACI SP-66 - ACI Detailing Manual.

B. ASTM International:
   1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   2. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
   3. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
   4. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   5. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
   6. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
   7. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
   8. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
   9. ASTM A775/A775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
   10. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
   11. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
   12. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.

13. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars.

C. American Welding Society:
1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

D. Concrete Reinforcing Steel Institute:
1. CRSI - Manual of Standard Practice.
2. CRSI - Placing Reinforcing Bars.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules.

C. Certificates: Submit AWS qualification certificate for welders employed on the Work.

D. Submit certified copies of mill test report of reinforcement materials analysis.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI - Manual of Standard Practice and ACI 301.

1.5 QUALIFICATIONS

A. Welders: AWS qualified within previous 12 months.

1.6 COORDINATION

A. Section 01300 - Administrative Requirements.

B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade; deformed billet steel bars, unfinished.

B. Reinforcing Steel Plain Bar and Rod Mats: ASTM A704/A704M, ASTM A615/A615M, Grade 60; steel bars or rods, unfinished.

C. Stirrups Steel: ASTM A82, unfinished.

D. Welded Steel Wire Fabric: ASTM A497 Deformed Type; in flat sheets or coiled rolls; galvanized finish.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.

C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic tipped steel type; size and shape to meet Project conditions.

D. Reinforcing Splicing Devices: Exothermic welding type; full tension and compression; sized to fit joined reinforcing.

2.3 FABRICATION

A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice.

PART 3 EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Do not displace or damage vapor retarder.

C. Accommodate placement of formed openings.

D. Maintain concrete cover around reinforcement as follows:

Item	Coverage
Concrete in contact with soil	3 inches
Exterior concrete	
Bars larger than No. 5	2 inches
No. 5 bars and smaller	2 inches

E. Conform to applicable code for all other conditions.

F. Splice reinforcing in accordance with splicing device manufacturer's instructions.

G. Lap length shall be as noted on the Drawings:

3.2 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements; Section 01700 - Execution Requirements.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
1. Cast-in-place concrete.
2. Formwork.
3. Reinforcing.
4. Mix Design.
5. Control, expansion and contraction joint devices.
6. Placement procedures.
7. Finishes.
8. Testing requirements.

B. Related Documents:
1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Cast-in-Place Structures:
1. Basis of Measurement: Cubic Yard or Lump Sum.
2. Basis of Payment: Includes all labor, material, and equipment required to construct the concrete structures shown on the Plans and/or reflected in the Bid Form. Includes placing and compacting of base material, formwork, underground piping, drains, conduit, reinforcement, pouring and finishing of concrete, removal of forms, water stops, water proofing, expansion and control joints, cleanup and all related items.

B. Concrete Driveway Replacement:
1. Basis of Measurement: Square Yard or Cubic Yard.
2. Basis of Payment: Includes all labor, materials, and equipment required to place concrete surface at the thickness and cured strength shown in the Plans and/or reflected in the Bid Form. Includes saw cutting and removal of existing surface, backfill materials per the Plans, wire mesh, pouring and finishing concrete drive, cleanup and all related work. Also, shall include coordination with any residents to provide an alternate entrance to their driveway while concrete is curing. The maximum width for payment shall be as noted on the Plans.

C. Minor Concrete Structures:
1. Basis of Measurement: Cubic Yard.
2. Basis of Payment: Includes all labor, material, and equipment required to replace or construct any minor or miscellaneous structures as indicated in the Plans, directed by the Engineer, and/or reflected in the Bid Form. Items could include curb and gutters, sidewalks, and small slabs.

1.3 REFERENCES

A. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 305 - Hot Weather Concreting.
   3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
   4. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:
   1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   2. ASTM C33 - Standard Specification for Concrete Aggregates.
   3. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
   4. ASTM C150 - Standard Specification for Portland Cement.
   5. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
   6. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
   7. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
   8. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
   9. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
   10. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
   11. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
   12. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
   13. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
   14. ASTM D1190 - Standard Specification for Concrete Joint Sealer, Hot-Applied Elastic Type.
   15. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
   16. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
   17. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
   18. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Product Data: Submit data on joint devices, attachment accessories, and admixtures.

C. Design Data:
   1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:

a. Hot and cold weather concrete work.
b. Air entrained concrete work.

2. Identify mix ingredients and proportions, including admixtures.

D. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

1.5 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements.

B. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.6 QUALITY CONTROL / QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Maintain one copy of each document on site.

C. Acquire cement and aggregate from one source for Work.

D. Conform to ACI 305 when concreting during hot weather.

E. Conform to ACI 306.1 when concreting during cold weather.

F. Concrete Testing Service: Contractor shall employ Three Notch Group to provide quality assurance testing during construction. Contractor is responsible to provide suitable quality control of materials, procedures, and of the mix design process to ensure the concrete conforms to the project plans and specifications. Submit quality control plan and proposed concrete mix designs to Engineer prior to concrete placement.

1.7 COORDINATION

A. Section 01300 - Administrative Requirements.

B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces.

1. Use overlaid plywood complying with U.S. Product Standard PS-1 “A-C or B-B High Density Overlaid Concrete Form”, Class 1.

2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class 1, Exterior Grade or better, mill-oiled and edge sealed, with each piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for a tight fit.

C. Form Coatings: Provide commercial formulation form coating compounds with a maximum VOC of 350 mg/l that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

D. Form Ties: Factory fabricated, adjustable length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615, Grade 60, deformed.

B. Welded Wire Fabric: ASTM A185 welded steel wire fabric.

C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire-bar type supports complying with CRSI specifications.
1. For slabs-on-grade use supports with sand plates or horizontal runners where base material will not support chair legs.
2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, class 1) or stainless steel protected (CRSI, class 2).
3. For sand blasted or intentionally roughened concrete surfaces, provide supports of stainless steel (CRSI, class 2).

D. Reinforcing Bars to be Welded: ASTM A706, "Specifications for Low Alloy Steel Deformed Bars for Concrete Reinforcement".

E. Bar and Rod Mats: ASTM A184 "Specifications for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement".

F. Threaded Dowels: Continuous Threaded high-strength steel bars. Provide inserts compatible with dowels, designed for ultimate pull-out force indicated on the Drawings.

G. Mechanical Splices: Equal to "Cadweld Rebar Splices", as manufactured by Erico Products, Inc., "C" Series, for developing 125% of minimum ASTM specified yield strengths, unless otherwise noted on Drawings.

H. Steel Shapes, Plates and Rods: Conform to ASTM A36 "Specifications for Structural Steel".

I. Do not weld reinforcing steel unless specifically noted on Drawings. If welding is shown, conform to latest revision of AWS D12.1, "Reinforcing Steel Welding Code of the

American Welding Society". Perform all welding with certified welders qualified per AWS.

2.3 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I – Normal, Portland type for all applications other than structures used in conjunction with wastewater projects. All wastewater related structures shall use Type V – Sulfate Resistant, Portland Cement.

B. Fly Ash: ASTM C618, Type C or Type F.
   1. Limit use of fly ash to not exceed 20 percent of cement content by weight.

C. Normal Weight Aggregate: ASTM C33 and as herein specified. Provide aggregates from a single source for exposed concrete.
   1. For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.

D. Water: Clean, potable.

E. Admixtures, General: Provide admixtures for concrete that contain not more than 0.1 percent chloride ions.

F. Air-Entraining Admixtures: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

G. Water Reducing Admixtures: ASTM C494, Type A.

H. High Range Water Reducing Admixtures (Super Plasticizer): ASTM C494, Type F or Type G.

I. Water Reducing, Non-Chloride Accelerating Admixture: ASTM C494, Type E.

J. Water Reducing, Retarding Admixture: ASTM C494, Type D.

K. All admixtures shall be supplied by the same manufacturer.

2.4 ACCESSORIES

A. Vapor Retarder: ASTM E1745 Class A; 6 mil thick fabric-reinforced plastic film, 0.03 perms; rated for below grade application. Furnish joint tape recommended by manufacturer.

B. Non-Shrink Grout: ASTM C1107, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

C. Concrete Reinforcing Fibers: ASTM C1116, high strength industrial-grade fibers specifically engineered for secondary reinforcement of concrete. Tensile strength 130 ksi; toughness 15 ksi; 3/4 inch long fibers, 34 million/lb fiber count.

D. Waterstops: Provide flat, dumbbell-type or centerbulb-type waterstops at construction joints and other joints as shown on the Drawings.

E. Granular Base: Evenly graded mixture of fine and course aggregates to provide, when compacted, a smooth and even surface below slabs on grade.

F. Sand Cushion: Clean, manufactured or natural sand.

G. Nonslip Aggregate Finish: Provide fused aluminum oxide granules or crushed emery as abrasive aggregate for nonslip finish. Material shall be factory graded, rustproof, non-glazing, and is unaffected by freezing, moisture, and cleaning materials.

H. Colored Wear Resistant Finish: Packaged, dry, combination of materials consisting of Portland cement, graded quartz aggregate, coloring pigments, and plasticizing admixture. Use coloring pigments that are finely ground, nonfading mineral oxides, interground with cement. Color as selected by Engineer.

I. Bonding Compound: Polyvinyl acetate or acrylic base.

J. Epoxy Adhesive: ASTM C881, two-component material suitable on dry or damp surfaces. Provide material type, grade and class to suit project requirements.

2.5 JOINT DEVICES AND FILLER MATERIALS

A. Joint Filler Type A: ASTM D994; Asphalt impregnated fiberboard or felt, thickness as indicated on the drawings; tongue and groove profile.

B. Joint Filler Type B: ASTM D1751; cellular bonded fiber material, non-extruding, resiliency recovery of 70 percent if not compressed more than 50 percent of original thickness.

C. Construction Joint Devices: Integral galvanized steel, formed to tongue and groove profile, with removable top strip exposing sealant trough, knockout holes spaced at 6 inches, ribbed steel spikes with tongue to fit top screed edge.

D. Expansion and Contraction Joint Devices: ASTM B221 alloy, extruded aluminum; resilient neoprene filler strip with Shore A hardness of 35 to permit plus or minus 25 percent joint movement with full recovery; extruded aluminum of longest manufactured length at each location, flush mounted.

E. Joint Sealant: ASTM C920, Type S; single component, self leveling, premium grade polyurethane sealant, equal to Sikaflex-1C SL.

2.6 CONCRETE MIX

A. Mix concrete in accordance with ACI 301. Deliver concrete in accordance with ASTM C94.

B. Select proportions for normal weight concrete in accordance with ACI 301 trial mixtures.

C. Provide concrete to the following criteria:

Unit	Measurement
Compressive Strength (f'c at 28 day)	As Indicated in Plans
Aggregate Size (maximum)	1 inch
Air Entrainment	4 to 6 percent
Slump	3 to 5 inches

D. Prepare design mixes for each type and strength of concrete by either laboratory trial mixture or field experience methods as specified in ACI 318-89 Section 5.3.

E. Mix design based on historical performances in accordance with ACI 318-89 Section 5.3, may be provided by a qualified concrete supplier or precast concrete manufacturer for concrete designs. Mix design shall be certified by an independent testing laboratory.

F. All concrete mix designs shall include the following information:
1. Proportions of cement, fine and course aggregates and water.
2. Water/cement ratio, design strength, slump and air content.
3. Type and source of cement and aggregates.
4. Type and dosage of all admixtures.
5. Any special characteristics of the mix which require precautions in the mixing, placing or finishing techniques to achieve the finished product specified.

G. Engineer to review and approve mix designs prior to start of concrete production.

H. Design mixes to provide normal weight concrete.

I. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer.

J. All mix design information and data shall not be older than 18 months from the date of the submittal.

2.7 ADMIXTURES

A. Use water reducing admixture or high range water reducing admixture (superplasticizer) in concrete as required for placement and workability.

B. Use high range water reducing admixture in pumped concrete, concrete required to be watertight, and concrete with water/cement ratio below 0.50.

C. Use nonchloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F.

D. Use air-entraining admixture in concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete having an air content of 4% to 6% at the point of placement.

E. Use admixtures for water reduction and set control in strict compliance with manufacturer's directions.

F. Temperature Limit: Do not place concrete if the concrete temperature exceeds 90ºF or the ambient temperature is 40ºF or less and falling.

G. Slump Limit: Proportion and design mixes to result in concrete slump of 3 to 5 inches at point of placement.

2.8 CONCRETE MIXING

A. Provide batch ticket for each batch used on the project. Batch ticket must indicate project name, contractor's name, date, mix type, mix time, batch time, quantity, and amount of water introduced.

B. Ready-Mix Concrete: Comply with requirements of ASTM C94, and as specified.
1. Addition of water to batch for material with insufficient slump will be permitted in accordance with ACI 301.
2. When air temperature is between 85 degrees F. and 90 degrees F., reduce mixing and delivery time from 1-1/2 hours to 75 minutes. When air temperature exceeds 90 degrees F. reduce mixing and delivery time to 60 minutes.
3. Concrete shall only be placed when the air temperature is above 40 degrees F. and rising.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Verify requirements for concrete cover over reinforcement.

C. Verify anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 FORMS

A. General: Design, erect, support, brace, and maintain formwork to support vertical and lateral, static and dynamic loads that might be applied until concrete structure can support such loads.

B. Maintain formwork construction tolerances complying with ACI 301 Table 4.3.1.

C. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, chamfers, blocking, bulkheads, anchorages, and other features required in work.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.

E. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar.

F. Chamfer exposed edges and corners as indicated using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items.

H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed.

3.3 VAPOR BARRIER

A. General: Following leveling and tamping of granular base for slabs-on-grade, place vapor barrier sheeting with longest dimension parallel with direction of pour.

B. Lap joints 6 inches and seal vapor barrier joints with manufacturer's recommended mastic and pressure-sensitive tape.

C. After placement of vapor barrier, cover with sand cushion and compact to depth as shown on Drawings.

3.4 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as herein specified.
   1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.

B. Clean reinforcement of loose rust and mill scale, earth ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure.

B. Provide keyways at least 1-1/2 inches deep in construction joints in walls, slabs, beams and between walls and footings.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated.

D. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

E. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Field-fabricate joints in waterstops according to manufacturer's printed instructions.

F. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

G. Contraction (Control) Joints in Slabs-On-Grade: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 1/8 inch wide by 1/4 slab depth or approved inserts, unless otherwise indicated. Make saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregates.
   1. With prior approval from Engineer contraction joints may be formed by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
   2. Refer to drawings for scoring pattern as shown. If joint pattern not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible.

3.6 PREPARATION OF FORM SURFACES

A. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.

B. Coat contact surfaces of forms with an approved, noresidual, low-VOC, form-coating compound before reinforcement is placed. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

C. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.7 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in.

B. General: Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete."

C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

E. Consolidate full depth of placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

F. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

G. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
   1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or derbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations
   3. Maintain reinforcing in proper position during concrete placement.

H. Cold-Weather Placing: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When placing concrete in cold weather, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
   2. Concrete shall only be placed when the air temperature is above 40 degrees F. and rising.
   3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   4. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

I. Hot-Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI305 and as herein specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, when acceptable to Engineer.

3.8 FINISH OF FORMED SURFACES

A. Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched. Fins and other projections exceeding 1/4 inch in height shall be rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

C. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled concrete surfaced, which have received smooth form finish treatment, not later than one day after form removal.

1. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

D. Grout-Cleaned Finish: Provide grout-cleaned finish to scheduled concrete surfaces that have received smooth form finish treatment.

1. Combine one part Portland dement to 1-1/2 parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to consistency of thick paint. Blend standard Portland cement and white Portland cement, amount determined by trial patches, so that final color of dry grout will match adjacent surfaces.
2. Thoroughly wet concrete surfaces apply grout to coat surfaces, and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.

E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture

matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

F. Unless otherwise noted on the Drawings, all exposed surfaces shall receive a smooth rubbed finish.

3.9 SLAB FINISHES

A. After placing slabs, plane surface to tolerances for floor flatness (Ff) of 15 and floor levelness (Fl) of 13. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushed, brooms, or rakes, as required.

B. Float Finish: Apply float finish to slab surfaces to receive trowel finish and other finishes as hereinafter specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and as otherwise indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand floating if area is small or inaccessibly to power units. Check and level surface plane to tolerances of Ff 18-Fl 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish: Apply trowel finish to slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.

1. After floating, begin first trowel finish operation using a power-driven trowel. Being final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of Ff 20-Fl 17. Grind smooth surface defects that would telegraph through applied floor covering system.

D. Nonslip Broom Finish: Apply nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

E. Nonslip Aggregate Finish: Apply nonslip aggregate finish to concrete stair treads, platforms, ramps, sloped walks, and elsewhere as indicated.

F. After completion of float finishing and before starting trowel finish, uniformly spread 25 lbs. of dampened nonslip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as herein specified.

G. After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose nonslip aggregate.

3.10 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting; keep continuously moist for not less than 7 days.

C. Curing Methods: Perform curing of concrete by curing and sealing compound, b moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

D. Provide moisture curing by following methods.
   1. Keep concrete surface continuously wet by covering with water.
   2. Use continuous water-fog spray.
   3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.

3.11 REMOVAL OF FORMS

A. General: Formwork not supporting weight of concrete, such as sides of beams, walls columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed until approved by the structural engineer.

C. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.12 CONCRETE SURFACE REPAIRS

A. General: No surface shall be patched or repaired until the Engineer had reviewed the defective condition and approved the Contractor's submitted repair and/or patching materials and procedures.

B. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Engineer.
   1. Cut of honeycomb, rock pockets, and voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of

less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar before bonding compound has dried.

2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

C. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry-pack mortar, or precast cement cone plugs secured in place with bonding agent.

1. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

D. Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope.

1. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, as such, include crazing and cracks in excess of 0.01 in wide or that penetrate to reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
3. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Engineer.
4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, when acceptable to Engineer by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

E. Repair isolated random cracks and single holes not over 1 inch in diameter by dry-pack method when acceptable to Engineer. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2

parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.

F. Perform structural repairs with prior approval of Structural Engineer for method and procedure, using specified epoxy adhesive and mortar.

G. Repair methods not specified above may be used, subject to acceptance of Engineer.

3.13 FIELD QUALITY ASSURANCE, CONTROL AND TESTING DURING CONSTRUCTION

A. General: The Owner may employ the Engineer or another professional firm to perform quality assurance testing during construction. The Contractor will notify the Engineer at least 24 hours prior to requiring tests. The Contractor is responsible to provide equipment to allow sampling and testing of the concrete at the point of placement.

B. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94. Perform the following tests.

1. Slump: ASTM C 143; one test at point of placement for each set of compression test specimens; additional tests when concrete properties appear to have changed.
2. Air Content: ASTM C 173 (volumetric method for lightweight or normal weight concrete) or ASTM C 231 (pressure method for normal weight concrete); one test at point of placement for each set of compression test specimens; additional tests when concrete properties appear to have changed.
3. Concrete Temperature: ASTM C 1064; test hourly when air temperature is 40ºF and below or 80ºF and above, and each time a set of compression test specimens is made.
4. Compression Test Specimen: ASTM C 31; one set of 4 cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cure test specimens are required.
5. Compressive Strength Tests: ASTM C 39; one set for each 50 cubic yards or fraction thereof for each concrete class placed in any one day. One specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing, if required.
6. When frequency of testing will provide fewer than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

C. Test results will be reported in writing to Engineer, Ready-Mix Producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete supplier and testing agency, concrete type and class, location of concrete placed in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but **shall not** be used as the sole basis for acceptance or rejection.

E. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been

attained in the structure, as directed by Engineer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

F. Quality Assurance consisting of testing and observation of a limited sampling of construction materials will be provided by the Owner for acceptance purposes. Passing test results are not a warranty, guarantee, or certification by the testing agency, Engineer, or Owner that all work was performed in conformance with the plans and specifications. Therefore, the Contractor should not rely solely on test results generated by the quality assurance process as an indication of the suitability of the construction.

G. It is entirely the Contractor's responsibility to perform quality control as necessary to construct the project in conformance with the plans and specifications. Deviations from the plans and specifications, whether identified during construction or following the completion of construction, must be corrected by the Contractor at no cost to the Owner.

3.14 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by Engineer.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

END OF SECTION

SECTION 05511

ALUMINUM STAIRS AND LADDERS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes aluminum stair frame of structural sections, with Open or Closed risers, open grate, integral balusters, and aluminum hand railing.

B. Related Sections:
1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.

B. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A283/283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
6. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
7. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
8. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
9. ASTM A501. - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
10. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
11. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
12. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

C. American Welding Society:
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. AWS D1.1 - Structural Welding Code - Steel.

D. National Association of Architectural Metal Manufacturers:
   1. NAAMM AMP 510 - Metal Stairs Manual.
   2. NAAMM MBG 531 - Metal Bar Grating Manual.

E. National Ornamental & Miscellaneous Metals Association:
   1. NOMMA Guideline 1 - Joint Finishes.

F. SSPC: The Society for Protective Coatings:
   1. SSPC - Steel Structures Painting Manual.
   2. SSPC SP 1 - Solvent Cleaning.
   3. SSPC SP 10 - Near-White Blast Cleaning.
   4. SSPC Paint 15 - Steel Joist Shop Paint.
   5. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.3 DESIGN REQUIREMENTS

A. Fabricate stair assembly to support uniform live load of 100 lb/sq ft and concentrated load of 300 lb/sq ft with deflection of stringer or landing framing not to exceed 1/180 of span. Minimum width of steps shall be 36 inches.

B. Railing assembly, wall rails, and attachments to resist a uniform load of 75 lbs at any point in any direction without damage or permanent set. Assembly must also withstand a concentrated load of 200 lbs applied at any point in any direction. Minimum height of rail shall be 42 inches with on intermediate rail 18 inches below the top rail.

C. Fabricate stair assembly to NAAMM AMP 510, Class Industrial.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

C. Shop Drawings: Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

D. Design Data: Submit design calculations.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM E985 - Permanent Metal Railing Systems and Rails for Buildings.

B. Perform work in accordance with NAAMM Metal Bar Grating Manual designated ANSI/NAAMM MBG 531 for Aluminum and light duty steel and Stainless-Steel Gratings, and MBG 532 for Heavy Duty Steel Gratings.

C. Finish joints in accordance with NOMMA Guideline 1.

D. Perform Work in accordance with State of Alabama Public Work's standard.

1.6 QUALIFICATIONS

A. Prepare Shop Drawings under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Alabama.

B. Welders' Certificates: Submit under provisions of Section 01300, certifying welders employed on the Work, verifying AWS qualification within previous 12 months.

1.7 PRE-INSTALLATION MEETINGS – **Not Applicable**

A. Section 01300 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 ALUMINUM STAIRS

A. Manufacturers:
1. Benko Products, Inc.
2. Lapeyre Stair.
3. The Sharon Co., Inc.
4. Substitutions: Section 01600 - Product Requirements.

2.2 COMPONENTS

A. Aluminum Sections: ASTM B221, Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubing.

B. Steel Sections if required: ASTM A36/A36M.

C. Steel Tubing If required: ASTM A500, Grade B

D. Plates if Required: ASTM A283/A283M.

E. Pipe if Required: ASTM A53/A53M, Grade B, Schedule 40.

F. Landing Concrete Reinforcement: Welded Wire Mesh type unfinished.

G. Bolts, Nuts, and Washers: ASTM A325 [galvanized to ASTM A153/A153M for galvanized components].

H. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; consistent with design of stair structure.

I. Welding Materials: AWS D1.1; type required for materials being welded.

J. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic or Type II Organic, zinc rich.

K. Gratings: NAAMM MBG 531, welded type.

L. Concrete: Type specified in Section 03300.

2.3 FABRICATION

A. Fit and shop assemble components in largest practical sections, for delivery to site.

B. Fabricate components with joints tightly fitted and secured.

C. Continuously seal joined pieces by continuous welds.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Welded Joints: NOMMA Guideline 1 Joint Finish.

F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

H. Accurately form components required for anchorage of stairs, landings, and railings to each other and to building structure.

2.4 FABRICATION - PAN STAIRS AND LANDINGS – **Not Applicable**

A. Fabricate stairs and landings with closed risers and treads of metal pan construction, ready to receive concrete.

B. Form treads and risers with minimum 11 gage sheet steel stock.

C. Secure tread pans to stringers with clip angles; bolted in place.

D. Form stringers with rolled steel channels, 12 inches deep. Weld facia plates to channels using 14gage steel sheet across channel toes.

E. Form landings with minimum 11 gage sheet stock. Reinforce underside with metal T's to attain design load requirements.

F. Form balusters with 1.5” inch diameter steel sections, welded to stringers.

2.5 FABRICATION - CHECKERED PLATE STAIRS AND LANDINGS – **Not Applicable**

A. Form treads with minimum 11 gage checkered steel plate; galvanized finish. Bolt to stringer support clips. Bend nosing to 4 inch radius and return down 4 inch.

B. Form stringers with rolled steel channels, 12 inches deep; galvanized finish.

C. Form landings with minimum 11 gage checkered steel plate; galvanized finish. Reinforced underside with metal T's to attain design load requirements.

D. Form balusters with 1.5” inch diameter steel sections, welded to stringers; galvanized finish.

2.6 FABRICATION - OPEN GRATING STAIRS AND LANDINGS

A. Fabricate treads 1 inch I-Bar in accordance with NAAMM MBG 531, of welded Aluminum bars, welded to supports with mill finish.

B. Form hollow stringers with rolled Aluminum channels with mill finish.

C. Form landings in accordance with NAAMM MBG 531 Aluminum mill finish. Reinforce underside with angles to attain design load requirements.

D. Form balusters with 11/4 inch diameter sections, welded to stringers with mill finish.

2.7 FABRICATION - UNIT STAIR TOWERS **– Not Applicable**

A. Fabricate self-supporting steel stair towers with formed treads and risers; steel channel stringers; landing platforms; sectioned for transport; corner structural support members designed to support full weight of complete stair tower plus design live load; with steel railings, and balusters.

B. Fabricate stair towers to height not exceeding 40 feet for transportation purposes; designed for stacking to height of building as self-supporting structure.

2.8 SHOP FINISHING

A. Prepare surfaces to be primed in accordance with SSPC SP 2.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Do not prime surfaces in direct contact with concrete or where field welding is required.

D. Prime paint items with two coats.

E. Galvanize items to minimum 1.25 oz/sq ft zinc coating in accordance with ASTM A123/A123M.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive work.

C. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates.

3.3 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Install anchors, plates, angles, hangers, and struts required for connecting stairs to structure.

C. Allow for erection loads. Install sufficient temporary bracing to maintain framing safe, plumb, and in alignment.

D. Field weld components indicated on shop drawings. Perform field welding in accordance with AWS D1.1.

E. Field bolt and weld to match shop bolting and welding. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

F. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.

G. Obtain approval of Engineer prior to site cutting or creating adjustments not scheduled.

H. After erection, prime welds, abrasions, and surfaces not galvanized, except surfaces to be in contact with concrete.

3.4 ERECTION TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

C. Maximum Offset From Alignment: 1/4 inch.

3.5 SCHEDULES

A. Stairs A and B: Pan stairs and landings, plastic handrail cover, primed finish.

B. Stair C: Checkered plate stairs and landings, galvanized finish. Pipe handrails specified in Section 05520.

END OF SECTION

SECTION 05520

HANDRAILS AND RAILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes steel and aluminum pipe railings, balusters, and fittings; and handrails.

B. Related Sections:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 REFERENCES

A. American Architectural Manufacturers Association:
   1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
   2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
   3. AAMA 2604 - Voluntary specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
   4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

B. ASTM International:
   1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   4. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
   5. ASTM B177 - Standard Guide for Chromium Electroplating on Steel for Engineering Use.
   6. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire.
   7. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   8. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
   9. ASTM B483/B483M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Tubes for General Purpose Applications.
   10. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.

11. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

C. National Ornamental & Miscellaneous Metals Association:
1. NOMMA Guideline 1 - Joint Finishes.

D. SSPC: The Society for Protective Coatings:
1. SSPC - Steel Structures Painting Manual.
2. SSPC Paint 15 - Steel Joist Shop Paint.
3. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.3 DESIGN REQUIREMENTS

A. Component handrail system shall be designed and constructed in strict compliance with the requirements of OSHA and the Standard Building Code.

B. Handrails shall be designed to withstand a uniform horizontal load of 50 pounds per foot with a simultaneous vertical load of 100 pounds per foot applied to the top rail.

C. In addition, handrails shall be designed to withstand a concentrated load of 200 pounds applied in any direction, at any point on the railing system.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

C. Samples: Submit one, 12 inch long samples of handrail. Submit one sample, of elbow Tee, escutcheon and end stop.

1.5 QUALITY ASSURANCE

A. Finish joints in accordance with NOMMA Guideline 1.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

B. Field fabrication of the railing system is not permitted.

PART 2 PRODUCTS

2.1 HANDRAILS AND RAILINGS

A. Manufacturers:
1. Thompson Fabricating, Birmingham, AL.
2. Hollaender Manufacturing Co., Cincinnati, OH.
3. Superior Aluminum Products, Inc., Russia, OH.

4. Substitutions: Section 01600 - Product Requirements.

2.2 ALUMINUM RAILING SYSTEM COMPONENTS

A. Rails and Posts: 1-1/2 inch diameter, schedule 40 aluminum pipe, alloy 6063-T6 or 6105-T5, ASTM B-429 or B-221. Post spacing shall be a maximum of 6'-0" on center.

B. Handrails shall be made of pipe and fittings mechanically fastened together with stainless steel hardware. Handrail systems which use fittings that are glued or pop-riveted will not be acceptable.

C. Toeboard, where shown or called out on the Drawings, shall conform to OSHA standards. Toeboard shall be a minimum of 4" high and shall attach to the post using clamps which will allow for expansion and contraction between posts. Toeboard shall be set 1/4" above the walking surface.

D. Openings in the railing shall be guarded by a self closing gate (OSHA 1910.23). Safety chains are not acceptable.

E. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

F. All handrail and components shall be clear anodized per Aluminum Association M10C22A41 (215-R1). The pipe shall be plastic qrapped to protect the finish.

G. All aluminum surfaces in contact with concrete, grout or dissimilar metals shall be protected with a coat of bituminous paint, mylar isolators or other approved material.

2.3 STEEL RAILING SYSTEM COMPONENTS

A. Pipe: ASTM A53/A53M, Grade B, carbon steel, Schedule 40.

B. Rails and Posts: 1.38 inch inside diameter steel pipe; welded or mechanical joints.

C. Fittings: Elbows, T-shapes, wall brackets, escutcheons; fabricated steel.

D. Mounting: Adjustable brackets and flanges, with steel inserts for casting in concrete or embedding in masonry.

E. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

F. Splice Connectors: Steel concealed spigots.

G. Galvanizing: To ASTM A123/A123M, minimum 2.0 oz/sq ft galvanized coating.
1. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic zinc rich.

H. Shop Prefinishing: Powder coated enamel. Color as selected by Owner.

2.4 FABRICATION

A. Fit and shop assemble components in largest practical sizes for delivery to site.

B. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate site assembly and installation.

C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

E. Drill condensate drainage holes at bottom of members at locations not encouraging water intrusion.

F. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

G. Accurately form components to each other and to related structure.

H. Accommodate for expansion and contraction of members and building movement without damage to connections or members.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Verify field conditions are acceptable and are ready to receive work.

C. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete, embedded in masonry or placed in partitions with setting templates, to appropriate sections.

3.3 INSTALLATION

A. Install components plumb within 1/8” of vertical and align horizontally to within 1/8” in 12 feet.

B. Anchor railings to structure with anchors. Install wedge anchors to proper depth to develop full pullout and shear values. Check all fasteners and bolts in base connections and splices for tightness.

C. Field weld anchors as indicated on shop drawings. Touch-up welds with primer. Grind welds smooth.

D. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

E. Assemble with spigots and sleeves to accommodate tight joints and secure installation.

F. Adequate provisions for expansion and contraction shall be incorporated into the rail.

G. Toeboards shall be shipped loose and attached to the handrail in the field. Attachment to the posts will be made with clamps which will allow for movement while maintaining a straight line.

H. All defective, damaged or otherwise improperly installed handrail shall be removed and replaced with material which complies with this section at no additional cost to the Owner.

I. Following installation, aluminum handrail shall be cleaned with mild soap and clean water. Acid solutions, steel wool or harsh abrasives shall not be used.

J. Following installation, steel handrails shall be painted unless galvanized.

END OF SECTION

SECTION 05530

GRATINGS AND PLATES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes formed floor, mezzanine, or stair tread gratings; flat surface floor plating; and perimeter closure.

B. Related Sections:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 REFERENCES

A. ASTM International:
   1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
   2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   4. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   5. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   6. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire.
   7. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

B. American Welding Society:
   1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   2. AWS D1.1 - Structural Welding Code - Steel.
   3. AWS D1.2 - Structural Welding Code - Aluminum.

C. National Association of Architectural Metal Manufacturers:
   1. NAAMM MBG 531 - Metal Bar Grating Manual.
   2. NAAMM MBG 532 - Heavy Duty Metal Bar Grating Manual.

D. SSPC: The Society for Protective Coatings:
   1. SSPC - Steel Structures Painting Manual.
   2. SSPC SP 1 - Solvent Cleaning.
   3. SSPC SP 10 - Near-White Blast Cleaning.
   4. SSPC Paint 15 - Steel Joist Shop Paint.
   5. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.3 PERFORMANCE REQUIREMENTS

A. Design Live (Pedestrian) Load: Uniform load of 200 lb/sq ft minimum with a maximum deflection of 1/4".

B. Maximum Spacing Between Bearing Bars: 1-3/16 inches on center.

C. Maximum Spacing Between Cross Bars: 4" on center.

D. Maximum fiber stress shall not exceed that which is allowed by the Aluminum Association.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Shop Drawings: Indicate details of gratings, plates, component supports, anchorage, openings, perimeter construction details, and tolerances. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

C. Product Data: Submit span and deflection tables.

D. Samples: Submit one sample, 6 inch x 6 inch in size illustrating surface finish, color, and texture.

E. Manufacturer's Installation Instructions: Submit special requirements.

1.5 QUALIFICATIONS

A. Design gratings and plates under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Alabama.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.7 COORDINATION

A. Section 01300 - Administrative Requirements.

B. Coordinate Work with placement of frames and tolerances for openings.

PART 2 PRODUCTS

2.1 GRATINGS AND FLOOR PLATES

A. Manufacturers:
   1. Thompson Fabricating Company.
   2. Ohio Gratings, Inc.
   3. Marco Specialty Steel, Inc.
   4. Substitutions: Section 01600 - Product Requirements.

2.2 COMPONENTS

A. Aluminum I-Bar Grating: ASTM B221 extruded aluminum alloy 6063-T6.

B. Aluminum stair treads shall be I-bar grating with an extruded aluminum corrugated nosing.

C. Cross Bars: ASTM B211.

D. Floor Plates: Aluminum checkered floor plates shall be 1/4" thick and shall be alloy 6061-T6 or 5086-H112.

E. Clips: 4 required per panel. Clips shall not protrude above the top of the grating.

F. Welding Materials: AWS D1.1, AWS D1.2, type required for materials being welded.

2.3 ACCESSORIES

A. Fasteners and Saddle Clips: Aluminum.

B. Perimeter Closure: Same material as grating.

C. Edge Banding: required at termination edges and at intermediate panel edges.

2.4 FABRICATION

A. Fabricate grates and plates to accommodate design loads and to sizes indicated.

B. Mechanically clinch joints of intersecting metal sections.

C. Fabricate support framing for all openings.

D. Top Surface of Grating: Serrated.

E. Top Surface of Plates: Checkered.

2.5 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Paint all aluminum surfaces in contact with concrete or dissimilar metals with a shop coat of bituminous paint.

D. Aluminum: Mill finish.

E. Stainless Steel: No. 4 finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Verify opening sizes and dimensional tolerances are acceptable.

C. Verify supports and anchors are correctly positioned.

3.2 INSTALLATION

A. Place frames in correct position, plumb and level.

B. Mechanically cut finish surfaces. Do not flame cut.

C. Anchor by bolting through saddle clips or flange blocks.

D. Set perimeter closure flush with top of grating and surrounding construction.

E. Secure to prevent movement.

F. Aluminum shelf angles shall be anchored to the concrete using stainless steel (type 18-8) wedge anchors.

3.3 ERECTION TOLERANCES

A. Maximum Space Between Adjacent Sections: 1/4 inch.

B. Maximum Variation from Top Surface Plane of Adjacent Sections: 1/16 inch.

3.4 CLEANING

A. Clean welds and damaged coatings and apply one coat of touch-up primer.

END OF SECTION

SECTION 09900

PAINTS AND COATINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes surface preparation and field application of paints, and other coatings.

B. Related Sections:
1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

A. Paintings and Coatings:
1. Basis of Measurement: Lump Sum
2. Basis of Measurement: Includes all labor, equipment and materials associated with the painting as designated in the Drawings including, cleaning, prepping, priming, painting, coordination of color selections with the Owner and Engineer, touchup, cleanup, and all related appurtenances.

1.3 REFERENCES

A. ASTM International:
1. ASTM D16 - Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
2. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.

B. Painting and Decorating Contractors of America:
1. PDCA - Architectural Painting Specification Manual.

C. SSPC: The Society for Protective Coatings:
1. SSPC - Steel Structures Painting Manual.

1.4 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

1.5 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Samples:
1. Submit one paper chip samples, 2" x 2" inch in size illustrating range of colors and textures available for each surface finishing product scheduled.

C. Manufacturer's Installation Instructions: Submit special surface preparation procedures, substrate conditions requiring special attention, and special curing requirements.

1.6 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements.

B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing work of this section with minimum three years documented experience and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements.

B. Deliver products to site in original manufacturer’s sealed and labeled containers; inspect to verify acceptability.

C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01600 - Product Requirements.

B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.

C. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

1.10 WARRANTY

A. Section 01700 - Execution Requirements.

B. Furnish two (2) year manufacturer warranty for paints and coatings.

1.11 EXTRA MATERIALS

A. Section 01700 - Execution Requirements.

B. Supply [1] one gallon of each color, type, and surface texture; store where directed.

C. Label each container with color, type, and texture in addition to manufacturer's label.

PART 2 PRODUCTS

2.1 PAINTS AND COATINGS

A. Manufacturers:
1. TNEMEC Company, Inc.
2. Substitutions: Section 01600 - Product Requirements

B. Substitutions:
1. Substitutions: Section 01600 - Product Requirements
2. Substitutions which decrease the film thickness, the number of coats applied, change the generic type of coating, or fail to meet the performance criteria of the specified materials will not be approved. Prime and finish coats of all surfaces shall be furnished be the same manufacturer.

C. Materials supplied by other manufacturers may be considered for substitution if the following prevailing conditions exist:
1. Performance criteria of the specified materials are exceeded by the submitted alternate materials as listed in paragraph 2.01 and detailed on the technical data sheets of each specified product.
2. The submittal must compare the performance criteria of the specified material with that of the substituted material and be documented in a side by side manner for the Engineer to review.
3. Substitute materials must be for complete systems and not individual products combined with the specified materials and the performance criteria for all products within a system must meet or exceed the specified materials.
4. Only one alternate submittal will be received for this specification and must be accompanied by a detailed statement of the sum to be added or deducted from the base bid should alternate materials be accepted.

2.2 COMPONENTS

A. Coatings: Ready mixed, except field catalyzed coatings. Prepare coatings:
1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
2. For good flow and brushing properties.
3. Capable of drying or curing free of streaks or sags.

B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified; commercial quality.

C. Patching Materials: Latex filler.

D. All coatings utilized shall be certified "non-lead" as defined in Part 1303 of the Consumer Product Safety Act B. All interior and exterior paint colors shall be certified to be lead free.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify surfaces are ready to receive Work as instructed by product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.

C. Test shop applied primer for compatibility with subsequent cover materials.

3.2 PREPARATION

A. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

B. Surfaces: Correct defects and clean surfaces capable of affecting work of this section. Remove or repair existing coatings exhibiting surface defects.

C. Marks: Seal with shellac those which may bleed through surface finishes.

D. Impervious Surfaces: Remove mildew by scrubbing with solution of [tetra-sodium] [tri-sodium] phosphate and bleach. Rinse with clean water and allow surface to dry.

E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high-pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.

F. Asphalt, Creosote, or Bituminous Coated Surfaces Scheduled for Paint Finish shall not be allowed. Such materials shall be delivered to the project site bare or shall be primed with the appropriate primer.

G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.

H. Concrete Floors: Remove contaminations, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

I. Copper Surfaces Scheduled for Paint Finish: Remove contamination by steam, high pressure water, or solvent washing. Mechanically scarify to provide a uniform anchor profile of at least 1.0 mil.

J. Copper Surfaces Scheduled for Natural Oxidized Finish: Remove contamination by applying oxidizing solution of copper acetate and ammonium chloride in acetic acid. Rub

on repeatedly for required effect. Once attained, rinse surfaces with clear water and allow to dry.

K. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.

L. Galvanized Surfaces: Remove surface contamination and oils in accordance with SSPC-SP 1 Solvent Cleaning. Mechanically abrade surfaces to be coated to provide a uniform anchor profile of at least 1.0 mil. Galvanized surfaces to be coated that will be placed in immersion service shall be abrasive blat cleaned to remove all contaminants and to provide a uniform anchor profile of at least 1.0 mil (reference SSPC-SP 13/ICRI CSP 1-2).

M. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

N. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

O. Uncoated Steel and Iron Surfaces: Remove grease, and other contaminants in accordance with SSPC-SP 1 Solvent Cleaning. All surfaces shall be abrasive blast cleaned in accordance with SSPC-SP 10 Near White Blast Cleaning. All surfaces shall be primed within eight hours of surface preparation and prior to the formation of any corrosion by-products.

P. Shop Primed Steel Surfaces (Immersion Service): Remove all oil, grease and other contaminants by cleaning in accordance with SSPC-SP 1 Solvent Cleaning. All area abraded to bare metal, or where corrosion is present, shall be cleaned in accordance with SSPC-SP 10 Near White Blast Cleaning. All edges shall be feathered. The remaining intact primer shall be cleaned in accordance with SSPC-SP 7u Brush-Off Blat Cleaning to provide a suitable uniform anchor profile. All surfaces shall be clean and dry.

Q. Shop Primed Steel Surfaces (Non-Immersion Service): Remove all oil, grease and other contaminants by cleaning in accordance with SSPC-SP 1 Solvent Cleaning. All area abraded to bare metal, or where corrosion is present, shall be cleaned in accordance with SSPC-SP 6 Commercial Blast Cleaning or SSPC-SP 11 Power Tool Cleaning to Bare Metal. All edges shall be feathered. All surfaces shall be clean and dry.

R. Previously Painted Steel Surfaces: Remove all oil, grease and other contaminants by cleaning in accordance with SSPC-SP 1 Solvent Cleaning. Clean all surfaces of loose paint, loose rust, as well as any other foreign matter in accordance with SSPC WJ4 “Light Cleaning”. All areas of corrosion shall be cleaned in accordance with SSPC-SP 11 Power Tool Cleaning to Bare Metal. All edges shall be feathered.

S. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

T. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.

U. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior paintable caulking compound after prime coat has been applied.

V. Exterior Wood Scheduled to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior caulking compound after sealer has been applied.

W. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.

X. Wood Doors Scheduled for Painting: Seal wood door top and bottom edge surfaces with clear sealer.

Y. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.

3.3 EXISTING WORK

A. Extend existing paint and coatings installations using materials and methods compatible with existing installations and as specified. Confirm existing paint conditions and generic type prior to starting surface preparation and paint application of existing coatings.

3.4 APPLICATION

A. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

B. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.

C. Sand wood surfaces lightly between coats to achieve required finish.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Where clear finishes are required, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.

F. Prime concealed surfaces of interior and exterior woodwork with primer paint.

G. Prime concealed surfaces of interior wood surfaces scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with thinner.

H. Finishing Mechanical and Electrical Equipment:

1. Refer to Section 15075 and Section 16075 for schedule of color coding and identification banding of equipment, duct work, piping, and conduit. See color schedule at the end of this Section.
2. Paint shop primed equipment.
3. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
4. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are shop finished.
5. Paint exposed conduit and electrical equipment occurring in finished areas.
6. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
7. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, and names.
8. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.5 FIELD QUALITY CONTROL

A. After application of each coating in the specified system and its surface has cured, measure its thickness with a properly calibrated Nordson Microtest Dry Film Thickness Gauge, or equivalent. Follow standard method for measurement of dry paint thickness with magnetic gauges as outlined in Steel Structures Painting Council's SSPC-PA2

B. Make as many determinations as needed to ensure the specified thickness values in each typical area. To all surfaces having less dry film thickness than specified, apply additional coat(s) at no extra cost to Owner to bring thickness up to specifications.

C. Structural metals in immersion service that receive a protective coating system shall be checked with a non-destructive holiday detector that shall not exceed 67 1/2 volts. All pinholes or defects shall be repaired in accordance with manufacturer's printed recommendations and then retested.

D. Masonry, drywall, or other non-metallic surfaces shall be continuously checked with wet-film thickness gauges during application to ensure proper dry film thickness will be attained. Also, square feet coverage needs to be monitored to verify proper coverage rates.

E Painting contractor shall permit Owner's Representative and/or paint & coating manufacturer (as requested by owner) to observe his work for conformance to this specification. Owner reserves the right to reject all work that does not comply with this specification.

3.6 CLEANING

A. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.

3.7 SCHEDULE

A. Steel - Structural, Tanks, Pipes and Equipment

1. Exterior, Non-Immersion
   Surface Preparation: SSPC-SP6 Commercial Blast Cleaning.
   Shop Primer: 91 H20 Hydro-Zinc at 2.5 – 3.5 mils DFT.
   Field Touch-Up: 91 H20 Hydro-Zinc at 2.5 – 3.5 mils DFT.
   1st Coat: 66-1255 Hi-Build Epoxoline at 4.0 - 6.0 mils DFT.
   2nd Coat: 1094 Endura-Shield at 2.0 - 3.0 mils DFT.
2. Immersion, Potable Water
   Surface Preparation: SSPC-SP10 Near-White Blast Cleaning.
   Shop Primer: 91 H20 Hydro-Zinc at 2.5 – 3.5 mils DFT.
   1st Coat: 20-1255 Pota-Pox at 4.0 - 6.0 mils DFT.
   2nd Coat: 141 Epoxoline at 10.0 – 12.0 mils DFT.
3. Immersion, Non-Potable Water
   Surface Preparation: SSPC-SP10 Near-White Blast Cleaning.
   Shop Primer: 1Omnithane at 2.5 – 3.5 mils DFT.
   1st Coat: 20-1255 Pota-Pox at 4.0 - 6.0 mils DFT.
   2nd Coat: 142 Epoxoline at 10.0 - 12.0 mils DFT.
4. Vapor Phase and Liquid Fluctuation Level, Non-Potable water with high levels of Hydrogen Sulfide.
   Surface Preparation: SSPC-SP10 Near-White Blast Cleaning.
   1st Coat: N140 Pota-Pox Plus at 4.0 – 6,.0 mils DFT.
   2nd Coat: 435 Perma-Glaze at 20.0 – 30.0 mils DFT.
5. Interior, Non-Immersion
   Surface Preparation: SSPC-SP6 Commercial Blast Cleaning.
   Shop Primer: 1 Omnithane at 2.5 – 3.5 mils DFT.
   1st Coat: 66-1255 Hi-Build Epoxoline at 4.0 - 6.0 mils DFT.
   2nd Coat: 1094 Endura-Shield at 2.0 – 3.0 mils DFT.
6. Interior and Exterior, non-Immersion, Previously Painted
   Surface Preparation: SSPC WJ4. SSPC-SP 11 corroded areas. Feather edges.
   Spot Primer: 135 Chembuild at 3.0 – 5.0 mils DFT.
   Full Primer: 135 Chembuild at 2.0 -3.0 mils DFT.
   Finish: 1094 Endura-Shield at 2.0 – 3.0 mils DFT.
7. Metal Anchorage for Buried Piping
   Surface Preparation: Shop Primed Materials - Clean and Dry or SSPC-SP3 Power Tool Clean.
   1st Coat: 46-465 H.B. Tnemecol at 8.0 -12.0 mils DFT.
8. Miscellaneous Castings, Including Manhole Rings and Covers
   Surface Preparation: SSPC-SP6 Commercial Blast Cleaning.
   1st Coat: 46H-413 Hi-Build Tneme-Tar at 12.0 - 16.0 mils DFT.
9. Factory Primed
   Surface Preparation: Surface shall be clean and dry.
   Shop Primer: 1 Omnithane at 2.5 – 3.5 mils DFT.
   Intermediate Coat: 1 Omnithane at 2.5 – 3.5 mils DFT.
   Finish Coat: See topcoat for exposure. System 3.04 A 1, 2, 4 or 6.

B. Steel Pipe

1. Exterior of Pipe, Non-Immersion
   Surface Preparation: SSPC-SP 6 Commercial Blast Cleaning.

Shop Primer: 91 H20 Hydro-Zinc at 2.5 – 3.5 mils DFT.
1st Coat: 66-1255 Hi-Build Epoxoline II at 4.0 - 6.0 mils DFT
2nd Coat: 1094 Endura-Shield at 2.0 -3.0 mils DFT.

2. Immersion, Non-Potable Water
Surface Preparation: SSPC-SP10 Near-White Blast Cleaning.
Shop Primer: 1 Omnithane at 2.5 – 3.5 mils DFT.
1st Coat: 20 Pota-Pox at 4.0 - 6.0 mils DFT.
2nd Coat: 142 Epoxoline at 10.0 - 12.0 mils DFT.

3. Immersion, Potable Water
Surface Preparation: SSPC-SP10 Near-White Blast Cleaning.
Shop Primer: 91 H20 Hydro-Zinc at 2.5 – 3.5 mils DFT.
1st Coat: 20 Pota-Pox at 4.0 - 6.0 mils DFT.
2nd Coat: 141 Epoxoline at 10.0 - 12.0 mils DFT.

C. Ductile or Cast Iron: Pipe and Miscellaneous Fabrications

1. Interior – Frequently Sweating Pipe
Surface Preparation: Surfaces shall be clean and dry. Abrasive blast in accordance with NAPF 500-03.
Shop Primer: N140 Pota-Pox Plus at 4.0 – 6.0 mils DFT
Full Field Primer: 20 Pota-Pox at 2.0 – 3.0 mils DFT.
Insulation Coating: 971 Aerolon at 100 mils DFT.
Finish: 1094 Endura-Shield at 2.0- - 3.0 mils DFT

2. Interior – Previously Painted - Frequently Sweating Pipe
Surface Preparation: SSPC WJ 4. All failing paint and corroded areas shall be cleaned in accordance with SSPC-SP 11 Power Tool Cleaning to Bare Metal. Surfaces shall be clean and dry.
Spot Primer: 135 Chembuild at 4.0 – 6.0 mils DFT
Full Primer: 135 Chembuild at 4.0 – 6.0 mils DFT.
Insulation Coating: 971 Aerolon at 100 mils DFT.
Finish: 1094 Endura-Shield at 2.0- - 3.0 mils DFT

3. Interior – Previously Painted – Dry Conditions
Surface Preparation: SSPC WJ 4. All failing paint and corroded areas shall be cleaned in accordance with SSPC-SP 11 Power Tool Cleaning to Bare Metal. Surfaces shall be clean and dry.
Spot Primer: 135 Chembuild at 4.0 – 6.0 mils DFT
Full Primer: 135 Chembuild at 4.0 – 6.0 mils DFT.
Finish: 1094 Endura-Shield at 2.0- - 3.0 mils DFT

4. Exterior and Interior: Non-Immersion
Surface Preparation: Surface shall be clean and dry. Abrasive blast in accordance with NAPF 500-03.
Shop Primer: N140 Pota-Pox Plus at 4.0 -6.0 mils DFT.
1st Coat: 66-Color Hi-Build Epoxoline at 4.0 - 6.0 mils DFT.
2nd Coat: 1094 Endura Shield at 2.0 – 3.0 - mils DFT.

5. Immersion, Potable Water
Surface Preparation: Surface shall be clean and dry. Abrasive blast in accordance with NAPF 500-03.
Shop Primer: N140 Pota-Pox Plus at 4.0 - 6.0 mils DFT.
Full Field Primer: 20 Pota-Pox at 4.0 – 6.0 mils DFT
Finish: 141 Epoxoline at 10.0 - 12.0 mils DFT.

6. Immersion, Non-Potable Water

Surface Preparation: Surface shall be clean and dry. Abrasive blast in accordance with NAPF 500-03.
Shop Primer: N140 Pota-Pox Plus at 4.0 - 6.0 mils DFT.
Full Field Primer: 20 Pota-Pox at 4.0 – 6.0 mils DFT
Finish: 142 Epoxoline at 10.0 - 12.0 mils DFT.

D. Chain Link Fences

1. Surface Preparation: Surfaces shall be clean and dry.
One Coat: 530 Omnithane 2.0 - 3.0 mils DFT.

E. Concrete, Dense Masonry

1. Exterior, Non-Immersion
Surface Preparation: Surface shall be clean and dry.
Two Coats: 156 Enviro-Crete at 6.0 - 8.0 mils DFT per coat.
2. Immersion – Potable Water and Non-Potable Water
Surface Preparation: Abrasive blast to remove curing compounds, hardeners, laitance, and to provide a suitable profile (reference SSPC-SP 13/ICRI CSP 5)
Surfacer: 218 Mortar-Clad at 1/8" minimum to all surfaces.
1st Coat: 20 Pota-Pox at 4.0 - 6.0 mils DFT.
2nd Coat: 22 Epoxoline at 20.0 – 30.0 mils DFT.
3. Interior, exposed to high levels of Hydrogen Sulfide and Sulfuric Acid Condensate.
Surface Preparation: Abrasive blast to remove curing compounds, hardeners, laitance, and to provide a suitable profile (reference SSPC-SP 13/ICRI CSP 5)
Surfacer: 218 Mortar-Clad at 1/8" minimum to all surfaces
1st Coat: 434 Perma-Shield H2S at 125 mils DFT.
2nd Coat: 435 Perma-Glaze at 15.0 mils DFT.
4. Fluoride Room, Floor & Walls
Surface Preparation: Abrasive blast to remove curing compounds, hardeners, laitance, and to provide a suitable profile (reference SSPC-SP 13/ICRI CSP 5)
Surfacer: 218 Mortar-Clad at 1/8" minimum to all surfaces
1st Coat: 120-5002 Vinester(*) at 12.0 - 18.0 mils DFT.
2nd Coat: 120-5001 Vinester at 12.0 -18.0 mils DFT.
Use 120-5003 Vinester Filler and Surfacer to fill bug holes and voids flush.
5. Chemical Storage, Containment Areas (Floor, Trench, Tank Pad, and 3'6" Band on Walls).
Surface Preparation: Abrasive blast to remove curing compounds, hardeners, laitance, and to provide a suitable profile (reference SSPC-SP 13/ICRI CSP 5)
Surfacer: 218 Mortar-Clad at 1/8" minimum to all surfaces
Base Coat: 239SC Chembloc @ 60 – 80 mils DFT. While still wet embed 211-215 Fiberglass Mat. Rib roll.
Saturant: 239 SC Chembloc at 8.0 – 12.0 mils DFT
Finish: 282 Tneme-Glaze @ 8.0 – 12.0 mils DFT.
2nd Coat: 275-Color Stranlok at 25.0 - 40.0 mils DFT.
3rd Coat: 282-Color Tneme-Glaze at 6.0 - 8.0 mils DFT.
6. Immersion or Non-Immersion, Dense Masonry – Clearwell, wetwells and secondary containment
Surface Preparation: Pressure Blast to achieve an open Capillary substrate.
1st Coat: Apply XYPEX Concentrate at 1.5 pounds per square yard.
2nd Coat: Apply XYPEX Mega-Mix I at ¼".
7. Interior, pipe gallery walls - Clear:

Surface Preparation: Rub seams and irregular areas
1st Coat: Chemprobe Series 660 Prima-A-Pell 200.
2nd Coat: Chemprobe Series 660 Prima-A-Pell 200.

F. Porous Masonry (CMU)

1. Exterior

Surface Preparation: Surface shall be clean and dry. Stone rub to remove loose and small particles from surface.
Filler: 130 Envirofill at 60 – 80 square feet per gallon
1st Coat: 156 Enviro-Crete at 6.0 - 8.0 mils DFT.
2nd Coat: 156 Enviro-Crete at 6.0 - 8.0 mils DFT

2. Interior

Surface Preparation: Surface shall be clean and dry. Stone rub to remove loose and small particles from surface.
Filler: 130 Envirofill at 60 – 80 square feet per gallon
1st Coat: 113 Tneme-Tufcoat at 4.0 – 6.0 mils DFT
2nd Coat: 297 Enviro-Glaze at 2.0 -3.0 mils DFT.

3. Exterior: Clear Sealer and/or Stain

Surface Preparation: Surface to be sound, dry and free of cracks, oils efflorescence, paint or other contaminates.
Sealer Coat: Apply TNEMEC Prima-Pell H_20 at 125 to 150 Sq. ft./gal
Stain Option: Apply Conformal Stain in accordance with manufacturers written application instructions at 75 to 125 sq.ft/gallon.

G. Concrete Floors

1. Interior

a. Pipe Gallery, Mechanical Rooms

Surface Preparation: See Product Data Sheet
2 coats: 629 CT Densifyer 201 at 300 to 350 sq. ft. per gallon.

b. Decorative - Lab area, Shower and Bathroom areas

Surface Preparation: Mechanically abrade to remove curing compounds, hardeners, laitance, and to provide a suitable profile (reference SSPC-SP 13/ICRI CSP 5)
1st Coat: 241 Ultra-Tread MVT at 1/8". Broadcast to refusal with Chromaquartz aggregate. Allow to cure and remove excess.
2nd Coat: 222 Deco-Tread at 20 mils DFT. Broadcast to refusal with Chromaquartz aggregate. Allow to cure and remove excess.
Grout Coat: 257 Excellathane at 8.0 – 12.0 mils DFT.
Finish: 248 Everthane at 2.0 – 3.0 mils DFT].

H. Concrete Structures.

1. Below Grade

Surface Preparation: Brush-off Blast.
One Coat: 46H-413 Hi-Build Tneme-Tar at 12.0 - 16.0 mils DFT.

I. Plaster and Wallboard

1. Interior

Surface Preparation: Surface shall be clean and dry.
Primer: 151 Elasto-Grip at 1.0 mil DFT

Finish: Two coats of 113-Color H.B. Tneme-Tufcoat at 4.0 - 6.0 mils DFT per coat.

J. Wood

1. Interior or Exterior

Surface Preparation: Surface shall be clean and dry. Sand smooth. Fill imperfections with suitable filler.
Primer: 10-99W Tnemec Primer at 2.0 – 3.o mils DFT
1st Coat: 1029 Enduratone at 2.0 - 3.0 mils DFT.
2nd Coat: 1029 Enduratone at 2.0 - 3.0 mils DFT.

K. Insulated Pipe

1. Interior

Surface Preparation: Surface shall be clean and dry
1st Coat: 1026 Enduratone at 2.0 - 3.0 mils DFT.
2nd Coat: 1026 Enduratone l at 2.0 - 3.0 mils DFT.

L. PVC Pipe

1. Interior

Surface Preparation: Surface shall be lightly sanded and be clean and dry.
Primer: 66 Build Epoxoline at 2.0 - 3.0 mils DFT.
Finish: 1094 Endura-Shield at 2.0 – 3.0 mils DFT.

M. Non-Ferrous Metals

1. Interior

Surface Preparation: SSPC-SP1 Solvent Cleaning. Mechanically abrade to produce a uniform 1.0 mil anchor profile.
Primer: 66-Color Hi-Build Epoxoline at 2.0 - 3.0 mils DFT.
Finish: 1094 Endura-Shield at 2.0 – 3.0 mils DFT

2. Exterior

Surface Preparation: SSPC-SP1 Solvent Cleaning. Mechanically abrade to produce a uniform 1.0 mil anchor profile.
Primer: 66-Color Hi-Build Epoxoline at 2.0 - 3.0 mils DFT.
Finish: 1094 Endura-Shield at 2.0 – 3.0 mils DFT

N. Brick

1. Exterior Sealer

Surface Preparation: Surface to be sound, dry and free of cracks, oils, efflorescence, paint or other contaminates.
Sealer Coat.: Apply TNEMEC Prima-Pell H_20 at 125 to 150 Sq. ft./gal

3.8 COLOR CODE FOR PROCESSING EQUIPMENT

A. Prior to beginning work verify colors for new equipment with Owner.

	GENERIC COLOR	COLOR IDENTIFICATION
WATER		
Raw Water	olive green	110GN Clover
Settled or Clarified Water	aqua	GB36 Aqua Sky
Finished or Potable Water	Dark Blue	11SF Safety Blue
WASTEWATER		
Sewage Plant Effluent	day*	07RD Terra Cotta
Backwash Waste	light brown	68BR Twine
Sludge	dark brown	84BR Weathered Bark
Sewer (Sanitary or Other)	dark gray	GR28 Fossil
CHEMICAL		
Alum or Primary Coagulant	orange	04SF Safety Orange
Ammonia	white	11WH White
Carbon Slurry	black	35GR Black
Caustic	yellow with green band	02SF Safety Yellow with 09SF Safety Green
Chlorine (Gas and Solution)	yellow	02SF Safety Yellow
Fluoride	light blue with red band	25BL Fountain blue with 06SF Safety Red
Lime Slurry	light green	PA30 Daiquiri Ice
Ozone	yellow with orange band	02SF Safety Yellow with 04SF Safety Orange
Phosphate Compounds	light green with red band	PA30 Daiquiri Ice with 06SF Safety Red
Polymers or Coagulant Aids	orange with green band	04SF Safety Orange with 09SF Safety Green
Potassium Permanganate	violet	14SF Safety Purple
Soda Ash	light green with orange band	PA30 Daiquiri Ice with 04SFSafety Orange
Sulfuric Acid	yellow with red band	02SF Safety Yellow with 06SF Safety Red
Sulfur Dioxide	light green with yellow band	PA30 Daiquiri Ice with 02SF Safety Yellow

	GENERIC COLOR	COLOR IDENTIFICATION
OTHER		
Compressed Air	dark green	94GN Balsam
Gas Tile	red	28RD Monterrey
Other Lines	light gray	32GR Light Gray
Hoists/trolleys	yellow*	02SF Safety Yellow
Fire Protection	red*	06SF Safety Red

* These generic colors are not part of the Recommended Standards for Water Works.

END OF SECTION

SECTION 09961

URETHANE LINING SYSTEM

PART 1 GENERAL

1.1 SCOPE

A. Description of Work

1. CONTRACTOR shall provide all labor, materials, tools and equipment necessary to field apply a urethane coating/lining system to all exposed interior concrete surfaces of the structure. The minimum dry film thickness shall be 125 mils.

1.2 SUBMITTALS

A. Shop Drawings and Manufacturer's Literature:

1. Submit shop drawings or manufacturer's "cut" of all material for this work in accordance with Section 01330.
2. The CONTRACTOR shall submit to the ENGINEER a sample of the surfacing system applied to a substrate material similar to this project application.
3. The sample shall be approximately 16 square inches and be surfaced with the material intended for use in this work and shall be of the thickness specified herein and of the color to be used.
4. A copy of the executed five (5) year warranty shall be submitted for approval prior to the installation of any products. Failure to submit warranty is grounds for rejection of all coating/linings system submittals.

1.3 QUALITY ASSURANCE

A. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM and NACE Standards.

B. Applicator shall use an adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts. These workmen shall be completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

C. Applicator shall use approved specialty equipment adequate in size capacity and number sufficient to accomplish work of this Section in a timely manner.

1.4 QUALIFICATIONS AND RESPONSIBILITY OF APPLICATOR

A. The Applicator shall apply the system and be responsible for the complete performance of the system, including materials, application and quality control. The applicator shall provide documentation that Applicator is an approved installer and licensed by the monolithic coating/lining system manufacturer and specialized equipment supplier for the installation of the material.

1.5 DELIVERY, STORAGE AND HANDLING

A. Materials are to be kept dry, protected from weather and stored under cover and stored between 50 degrees F and 100 degrees F. Materials should not be stored near flame, heat or strong oxidants.

B. Protective coating materials are to be handled according to their material safety data sheets.

1.6 ENVIRONMENTAL CONDITIONS

A. The CONTRACTOR shall provide and maintain safe working conditions for all employees. Fresh air ventilation shall be provided to continuously remove fumes from working spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside. Respirators shall be used for spraying type operations. Fumes shall, if possible, be exhausted to the outside from the lowest level in the confined space. Electrical fan motors shall, if located in the working space, be explosion proof. No smoking or open fires will be permitted in the working space.

1.7 SCAFFOLDING AND PROTECTION

A. Furnish, maintain and remove all scaffolding, ladders and planks required for this work and all drop cloths for the protection of concrete walks, floors, pre-finished materials, building fixtures, etc. Finished surfaces subject to damage or defacement due to other work on the building shall be properly protected and covered. The CONTRACTOR shall be responsible for any and all damage to work performed under this Section and to that of other work caused by operations under this Section.

1.8 WARRANTY

A. The CONTRACTOR, at no additional expense to the OWNER, shall provide an unconditional 5-year warranty against defects of material and workmanship discovered during the warranty period. The Warranty shall commence on the date of final payment for this work.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. The lining system shall be a product of one of the following systems. Manufacturer's:
   1. Sprayroq, Inc., Birmingham, Alabama.
   2. The product of a manufacturer meeting all aspects of this specification as approved by the ENGINEER.

2.2 MATERIALS

A. Urethane Liner System:
   1. The resin material shall be used to form the sprayed on structurally enhanced monolithic liner covering all interior surfaces of the structure including benches and inverts of manholes, walls, floors, and ceilings of wet wells and receiving pits, and all other surfaces noted on the Plans or in the Specifications. The finished liner shall conform to the minimum physical requirements listed below:

Compressive Strength	ASTM D 695	14,000 psi
Tensile Strength	ASTM D 638	5,000 psi
Shrinkage	ASTM D 2566	½ of 1%
Flexural Strength	ASTM D 790	10,000 psi
Bond	Shall exceed tensile strength of substrate	
Flexural Modulus (initial)	ASTM D 790	555,000 psi
Density		81+/- pcf

2. The finished structure shall be corrosion resistant to: Hydrogen Sulfide; 20% Sulfuric Acid; 17% Nitric Acid; 5% Sodium Hydroxide as well as common ingredients of the sanitary sewage environment.
3. The wall of the resin liner will be either structurally designed to withstand the hydraulic load generated by the groundwater table or merely function as a corrosive barrier. The long term (50 yr.) value of the flexural modulus of elasticity will be a minimum of 500,000 psi and is an internal part of the engineering equation used to design the wall thickness of the structural liner.
4. For this reason the value of the long term flexural modulus of the proposed product will be certified by an independent, third party testing lab and submitted with the design calculations for each individual structure. (Long term value will be based on a fifty (50) year minimum period and verified by DMA testing.)
5. When groundwater loading is not an issue and only a corrosion barrier required, the lining may be installed to the thickness necessary to qualify as a monolithic (void free) liner. The roughness of the substrate will dictate the thickness needed to create the monolithic liner and eliminate any opportunity for voids in the lining. For this reason the substrate will need to be carefully examined and the extent of the deterioration disclosed. Normally most corrosion barrier rehabilitations may be mils. However, some installations with slight corrosion deterioration are able to create a monolithic liner by applying an average of 125 mils.
6. In the case of new construction were the walls are extremely smooth and have no voids, a minimum lining thickness of 100 mils can successfully achieved to protect surfaces from future decay.

B. Substrate Patching Mix
1. A quick setting cementations material shall be used as a patching mix. It shall be mixed and applied according to the manufacturer's recommendations and shall meet the following minimum requirements:

Compressive Strength	ASTM C 579 B	1400 psi @ 6 hr.
Shrinkage	ASTM C 590	60% @ 90% rel. humidity
Bond	ASTM C 321	150 @ 28 days
Density when Applied		105+/- pcf

C. Substrate Infiltration Control Mix
1. A rapid-setting cementations product specially formulated for leak control shall be used to stop minor water infiltration, shall be mixed and applied according to the manufacturer's recommendations and shall meet the following minimum requirements:

Compressive Strength	ASTM C 579 B	600 psi @ 1 hour
Compressive Strength	ASTM C 579 B	1000 psi @ 24 hours
Bond	ASTM C 321	30 psi @ 1 hour
Bond	ASTM DC 321	80 psi @ 24 hours

D. Grouting Mix
1. A cementations grout shall be used for stopping very active infiltration, filling voids, and shall be mixed/applied according to manufacturer's recommendations. The grout shall be volume stable and have a minimum 28 day strength of 250 psi and 1 day strength of 50 psi.
2. Chemical grouts used for stopping very active infiltration shall be mixed and applied per manufacturer's recommendations.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

A. The system shall be applied in the field after all other work to the structure is completed. This will insure a continuous lining across the joints and connections. The monolithic surfacing system shall be continuously bonded to all brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the structure according to ASTM C882, Testing and therefore, shall be designed for hydrostatic loading.

B. The primer system shall be as recommended by the topcoat manufacturer.

C. The topcoat system shall provide a minimum dry film thickness of 125 mils exclusive of the substrate repairs, surface and primer.

D. The cured lining shall provide a sealed interface at all unsurfaced (piping, etc.) areas and shall be placed and cured in conformance with the recommendations of the 100% solids, rapid cure, two-component modified urethane surfacing system manufacturer. When cured, the system shall form a continuous, tight-fitting, flexible, impermeable surfacing that is suitable for domestic wastewater system service and chemically resistant to any chemicals, bacteria, or vapor normally found in domestic wastewater. The system shall be compatible with the thermal conditions of the existing surfaces.

3.2 PROTECTIVE COATING APPLICATION EQUIPMENT

A. Application of the primer shall be by standard airless spray equipment meeting the specifications of the product manufacturer.

3.3 PRE-COAT INSPECTION

A. The applicators vehicles and equipment must be able to access the structures to be coated under their own power.

B. All surfaces, including benches, inverts, joints, lift holes, and walls shall be made smooth and suitable for application of the interior surfacing system. All benches and inverts shall be in place and complete.

C. Active slows shall be dammed, plugged, or diverted as required to ensure that the liquid flow is maintained below the surfaces to be coated.

D. Installation of the protective coating shall not commence until the concrete substrate has properly cured.

3.4 SURFACE PREPARATION

A. Applicator shall inspect all surfaces specified to receive the lining system prior to surface preparation. Applicator shall notify ENGINEER of any noticeable disparity in the surfaces that may interfere with the proper preparation or application of the monolithic surfacing system.

B. All concrete that is not sound, or has been damaged by chemical exposure, shall be restored to a sound concrete surface. All contaminants including: all oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.

C. Surface preparation method(s) shall be based upon the conditions of the substrate and the requirements of the lining system manufacturer.

D. New concrete shall be cured a minimum of 28 days at 75 degrees Fahrenheit or equivalent prior to coating application.

E. Check for excess moisture in accordance with ASTM C 4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

F. Remove all oil, grease, dirt, water or other contaminants in accordance with ASTM D 4258 and SSPC-SP-1.

G. Abrasive grit blast, wet abrasive blast or high pressure water blast all surfaces to be coated, to remove all laitance, efflorescence, surface hardness, curing compounds, old coatings, and loose concrete, in accordance with SSPC-SP-13/NACE No. 6 or ASTM D 4259. A surface texture similar to that of medium-coarse sandpaper should be attained.
   1. The compressed air supply shall be completely free of al oil, water and other contaminants and provide the required volume of air at 100 psi or greater.
   2. Abrasives used shall be clean, a uniform grade and of an appropriate size to obtain the finish and profile required. DO NOT use contaminated abrasives.
   3. Water used with high-pressure water blasting or wet abrasive blasting shall be clean potable water.

H. Thoroughly clean all blasted surfaces to remove all dust and debris after dry blasting, or remove all water, sludge and debris after wet blasting.

I. Repair or remove or fill all cracks, voids, honeycombs, fins and other surface irregularities using a patching method recommended by the finish coating manufacturer.

J. Grind all form ties or other metallic protrusions below the surface then patch or fill.

K. All expansion joints and moving cracks which have opened to a width of 1/16” or greater must be repaired with elastomeric caulking material per the caulking manufacturer’s instructions.

L. Immediately prior to the application of the concrete surface or primer, thoroughly vacuum clean all surfaces to be coated effectively removing all remaining dust.
   1. Vacuum cleaning a roughened concrete surface is the only known effective method of removing dust from deep pits, cracks, crevices, bug holes, etc. and is considered a mandatory procedure.

3.5 APPLICATION OF FIELD APPLIED MONOLITHIC SURFACING SYSTEM

A. Application procedures shall conform to the recommendations of the two-part modified urethane monolithic coating/lining system manufacturer, including material handling, mixing, and environmental controls during application, safety, and equipment.

B. Newly constructed below or at grade concrete walls and slabs that will be internally coated must have a sheet or coating vapor barrier installed on the unprotected side of the concrete.

C. To minimize outgassing problems, all coating should be applied when the surface temperature of the concrete is declining.

D. Due to the inconsistent nature of concrete, surface porosity can vary greatly so a surface should always be used to reduce the occurrence of outgassing and pinholes. Extreme cases of surface porosity may require multiple coats of the surface or primer.

E. Specially designed plural component equipment designed to proportion the tow components utilizing airless spray guns shall be sued to apply each coat of the system.

3.6 TESTING AND INSPECTION

A. During application, the Applicator shall pay particular attention to the volume/time ration of the application to ensure a monolithic coating and uniform thickness during application of a minimum thickness of 125 mils. After a minimum of 24 hours following completion, the ENGINEER may direct the CONTRACTOR to perform a series of 2" diameter core drills to provide verification of lining thickness throughout the applied liner system. A maximum of one core drill per 100 square feet will be required.

1. Lining thickness at each core drill shall be collected.
2. All lining thicknesses will be added together, then, divided by the number of core drills to provide an average thickness.

If the lining system thickness proves to be below that specified, the averaged thickness will be used to prorate payment for the applicator's services based on the Bid Item as shown in the Proposal. Payment will be reduced by a similar percentage as calculated on the actual applied thickness compared to the specified thickness.

No additional payment will be made for this test or for repair of the lining system.

B. After a minimum of 24 hours following completion, the lining system shall be spark tested to ensure a pinhole-free lining. Defects must be patched per the manufacturer's instructions. The test voltage shall be a minimum 100 volts per mil of applied coating thickness. The holiday detector shall be a Tinker Razor Model AP/W or an approved equal. The applicator may enlist the services of an independent certified NACE inspector if desired.

C. The ENGINEER and the Applicator shall make a final visual inspection. Any deficiencies in the finished system shall be marked and repaired according to the procedures set forth herein by applicator.

3.7 REPAIRS

A. All damaged areas, faulty areas, and pinholes found during testing and inspection shall be repaired by the CONTRACTOR in accordance with the procedures recommended by the coating/lining system manufacturer.

B. All core drilled holes shall be cleaned, primed, repaired and coated in accordance with liner system manufacturer's recommendations in order to maintain the system integrity and five (5) year warranty.

C. The complete monolithic coating/ling system, including the repaired areas shall be inspected and tested in accordance with Section 3.6 of these specifications. The CONTRACTOR shall repeat Section 3.7 until no further defects are detected.

3.8 FINAL INSPECTION, PAYMENT AND WARRANTY

A. The monolithic coating/lining system shall be considered complete and accepted subject to passing the inspection criteria listed under Sections 3.6 and 3.7.

B. Payment for this item of work shall be made when work is complete in accordance with this specification and after clean-up of all associated construction debris, empty containers, etc.

C. The CONTRACTOR shall warrant this work for a period of five (5) years. During this time period, the CONTRACTOR shall make all repairs to the monolithic coating/lining system at no expense to the OWNER.

END OF SECTION

SECTION 11050

FABRICATED SLIDE GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Slide Gates.
   2. Weir Gates
   3. Operators

B. Related Documents:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 GENERAL

A. Slide and weir gates, including lifts, stems, and accessories, shall be of the size and type shown on the Drawings.

B. Where possible, gates shall be installed so that there is a seating head on the gate.

C. See Schedule for gate type, lift type, frame size, type, and seating head.

1.3 SUBMITTALS

A. Shop Drawings: Indicate equipment locations, dimensions, details of attachment, anchors, and materials.

1.4 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section with a minimum of five years experience.

B. Gates shall be shop inspected for proper operation before shipping.

C. Manufacturer shall be ISO 9001 certified.

1.5 WARRANTY

A. Furnish manufacturer's one year warranty for each gate including lift and actuator.

1.6 PERFORMANCE

A. Leakage Requirement:
   1. Gates shall be substantially watertight under the design head conditions.
   2. Leakage shall not exceed 0.05 gallons per minute per foot of seal periphery under the design head and 0.1 gallon per minute per foot of seal periphery for the design unseating head.

B. Design Head:
   1. Gates shall be designed to withstand the maximum design head (height of the slide).

C. Seal Test Performance:
   1. The gate's sealing system shall be tested through a cycle test in an abrasive environment indicating the leakage requirements are still met after 25,000 cycles with minimum deterioration.

PART 2 PRODUCTS

2.1 GENERAL

A. Gates shall be either self-contained or non self-contained of the rising stem configuration.

B. Manufacturers:
   1. Hydro Gate.
   2. Whipps, Inc.
   3. H. Fontaine Ltd.
   4. Substitutions: Permitted.

2.2 COMPONENTS

A. Frame:
   1. Frame Material: Aluminum.
   2. Frame shall be flat back or channel mount. Spigot-back frames are not acceptable.
   3. The frame shall be an integral unit of structural shapes, rigidly assembled to form the waterway opening
   4. The frame members shall form guides for the slide, and holes shall be provided for mounting of anchor bolts.
   5. The guide slot shall be made of ultra high molecular weight polyethylene.

B. Seal:
   1. Neoprene J-seals shall be securely fastened to the frame with formed stainless steel retainers and shall be replaceable and adjustable without removing the gate from the installed position.

C. Stem:
   1. The operating stem shall be stainless steel designed to transmit in compression at least two times the rated output of the operating manual mechanism with a 40 lb effort on the crank or handwheel.

2. Stems shall have rolled threads.
3. The stem shall be supported by angle guides or cast iron with a 2-piece cast bronze guide collar.
4. Stems shall withstand 1.25 times the stalled motor thrust of the actuator.

D. Slide:
1. The slide shall be of aluminum plate, no less than 1/4 inch thick.
2. The stem connector clips or stem block pocket shall be welded to the slide.

E. Manual Lift:
1. Gate lifts shall be handwheel or geared crank type as shown in the Schedule.
2. Lifts shall operate with a maximum pull of 40 lb on the handwheel or crank.
3. Handwheel or crank shall be located approximately 36 inches above grating or walkway.
4. Lifts shall have thrust bearings, bronze lift nuts and a bronze stop nut to limit the travel of the stem and slide.
5. All lifts shall be the rising stem type.
6. Stem covers made of clear butyrate shall be furnished for all lifts.
7. Lifts shall be grease lubricated and regreasable through grease zerks.

F. Motor Operator:
1. Motor operator shall be a 460V, 3-phase, 60 Hz motor with precision reduction gearing enclosed in weatherproof housing.
2. The operator shall be designed to raise the gate at the rate of approximately 12 inches/minute.
3. Integral controls shall include a control power transformer, reversing controller, torque switches, limit switches, space heater to prevent condensation, open-stop-closed push buttons and gate position indicator.
4. Motor reduction helical gear and pinion shall be of heat-treated alloy steel.
5. Final reduction worm shall be of alloy steel and worm gear of machined high-tensile strength bronze.
6. All gearing shall be proportioned for 100% overload conditions.
7. Operator shall have a declutch lever and handwheel for manual operation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify channel and concrete wall are ready to receive work and opening dimensions are as indicated on shop drawings.

B. Verify that all parts of the slide/weir gate assembly are included.

3.2 INSTALLATION

A. Install in accordance with the manufacturers instructions.

B. Secure frame to concrete wall with stainless steel anchor bolts, level and plumb.

C. Install gate into frame without binding.

D. Attach operator and manually operate the gate through two complete open/close cycles.

E. Adjust limit switches on the electric operator, if used.

END OF SECTION

SECTION 11217

PACKAGED LIFT STATION

PART 1 GENERAL

1.1 SUMMARY

A. Description:
   1. The Contractor shall furnish, install, test and place in satisfactory operation, as shown on the Plans and specified, two (2) wet-pit, non-clog submersible pump(s) and related accessories in a new prefabricated fiberglass lift station, controls, and all appurtenances, accessories and spare parts as will be required to produce a complete and workable installation.

B. Related Sections:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 REFERENCES

A. American National Standards Institute (ANSI) and American Water Works Association (AWWA)
   1. ANSI B16.1 - Cast iron pipe flanges and flanged fittings
   2. ANSI/AWWA C115/A21.51 - Cast/ductile iron pipe with threaded flanges
   3. ANSI 253.1 - Safety Color Code for Marking Physical Hazards
   4. ANSI B40.1 - Gauges, Pressure and Vacuum
   5. AWWA C508 - Single Swing Check Valves
   6. AWWA C504 - Plug Valves

B. American Society for Testing and Materials (ASTM)
   1. ASTM A48 - Gray Iron Castings
   2. ASTM A126 - Valves, Flanges, and Pipe Fittings
   3. ASTM A307 - Carbon Steel Bolts and Studs
   4. ASTM F593 - Stainless Steel Bolts, Hex Cap Screws, and Studs
   5. ASTM A36 - Structural Steel

C. Institute of Electrical and Electronics Engineers (IEEE)
   1. ANSI/IEEE Std. 100 - Standard Dictionary of Electrical Terms
   2. ANSI/IEEE Std. 112 - Test Procedure for Polyphase Induction Motors
   3. IEEE Std. 242 - Protection of Industrial and Control Power Systems

D. National Electric Code (NEC), National Electrical Manufacturers Association (NEMA)
   1. NEC - National Electric Code
   2. NEC 701 - National Electric Code article 701
   3. NEMA Std. MG1 - Motors and Generators

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Shop Drawings:
   1. Submit detailed dimensions for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.
   2. Include manufacturer's specified displacement tolerances for vibration at operational speed specified for pumps.

C. Product Data: Submit information concerning materials of construction and fabrication.

D. Manufacturer's Installation Instructions: Submit detailed instructions on installation requirements including storage and handling procedures, anchoring, and layout.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

F. Manufacturer's Field Reports: Certify equipment has been installed in accordance with manufacturer's instruction.

G. Other Information: Technical manuals, parts list, warranty information, equipment storage recommendations.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

C. Operation and Maintenance Data:
   1. Submit five (5) copies of operation and maintenance data in three-ring hard-backed binder, with cover indicating Owner specified station name.
   2. Submit maintenance instructions for equipment and accessories.
   3. Furnish list of equipment and tools needed to maintain and calibrate equipment.
   4. Include detailed dimensions for materials and equipment, including wiring and control diagrams, performance charts and curves, electrical motor data, installation and anchoring requirements, fasteners, recommended spare parts list, equipment start-up documentation.
   5. Motor performance chart exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. Data to include motor starting and no-load characteristics.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Owner's standard.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. The manufacturer shall have a minimum of five installations of the exact combination of pump and motor model proposed to be furnished for this project. Installations must be in operation for a minimum of five years and shall list the pump model, motor model and horsepower, date of installation, duty point, and contact information including telephone number. A list of these installations shall be furnished to the Engineer with submittals.

1.7 PRE-INSTALLATION MEETINGS

A. Section 01300 - Administrative Requirements.

B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements.

B. Inspect for damage.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces. Store and handle products in accordance with manufacturer's recommendations.

1.9 SEQUENCING

A. Section 01100 - Summary.

B. Sequence work to prevent interference with Owner's operation.

1.10 SCHEDULING

A. Section 01300 - Administrative Requirements.

B. Schedule work to install pumps in wet well prior to connecting piping work.

1.11 COORDINATION

A. Section 01300 - Administrative Requirements.

B. Coordinate installation and start-up with Owner and Engineer.

1.12 MAINTENANCE MATERIALS

A. Section 01700 - Execution Requirements.

B. Furnish one complete rebuild kit for each pump.

C. Furnish special tools required for equipment maintenance.

PART 2 PRODUCTS

2.1 STATION ENCLOSURE

A. Station Construction

1. Station shall be fabricated of fiberglass suitable for sewage catch basins. All walls shall be continuous and watertight and shall be supported by reinforcing members where required. Fabrication and erection shall conform to the appropriate requirements. Connections shall conform to the requirements of the American Plumbing Code and shall develop the full strength of the member.
2. Materials of construction used in the station shall be commercial grade and shall either be evaluated as a laminate by test or determined by previous service to be acceptable for the environment.
3. The resins used shall not contain fillers except as required for viscosity control. Up to five percent by weight of thixotropic agent, which will not interfere with visual inspection, may be added to the resin for viscosity control. Resins may contain pigments and dyes by agreement between the fabricator and the purchaser, recognizing that such additions may interfere with visual inspection of laminate quality.
4. The reinforcing material shall be a commercial grade of glass fiber having a coupling agent, which will provide a suitable bond between the glass reinforcing and the resin.
5. The station shall be of the laminated type construction. The laminate shall consist of an inner surface, an interior layer, and an exterior layer of laminate body.
6. The inner surface shall be free of cracks and crazing with a smooth finish and with an average of not over two pits per square foot, providing the pits are less than 1/8" in diameter and not over 1/32" deep and are covered with sufficient resin to avoid exposure of inner surface fabric. Same waviness is permissible as long as the surface is smooth and free of pits. Between 0.010 and 0.020 inches of resin-rich surface shall be provided. This will be a gel-cote surface.
7. A minimum of 0.100 inch of the laminate next to the inner surface shall be reinforced with not less than 20 percent or more than 30 percent by weight of non-continuous glass strands having fiber lengths from 0.5 to 2.0 inches.
8. The exterior layer of body of laminate shall be of construction suitable for the service intended and contain sufficient glass by weight to provide aggregate strength necessary to meet the tensile and flexural requirements. Where separate layers such as mat, cloth or woven roving are used, all layers shall be lapped a minimum of one inch. Laps shall be staggered as much as possible. If woven roving of cloth is used, a layer of chopped strand glass shall be placed as alternate layers. The exterior surface shall be relatively smooth with no exposed fibers of sharp projections. Handwork finished is acceptable, but enough resin shall be present to prevent fiber show.
9. SURFACE HARDNESS - The laminate shall have a Barcol hardness of at least 90 percent of the resin manufacturer's minimum specified hardness for the cured resin when tested. This applies to both interior and exterior surfaces.
10. APPEARANCE - The finished laminate shall be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, air bubbles, pin holes, pimples, and delamination

B. Anti-Floatation Flange

1. When the basin is constructed and anti-floatation flange is applied, pump-mounting studs shall be located in the basin bottom. Pump-mounting studs shall be stainless steel and mounted in a 1/4" (minimum) steel plate. The plate shall be drilled and tapped 3/8" for studs to thread into. Studs are welded on the bottom of the plate. The stud plate is fastened in place and another laminate of fiberglass is molded to the bottom to complete the basin construction.

C. Wetwell Chamber
1. A wetwell chamber shall be provided and shall be of the sufficient capacity to provide an efficient pumping operation. The wetwell shall be equipped with access lid, air vent and bug screen, submersible pump system, inlet and outlet connections, electrical control panel and level sensors.
2. The access lid and frame assembly shall be provided in the top of the wetwell structure. The access door shall have means of locking and a latch to hold the door in the open position.
3. Air vent and bug screen shall be constructed of the configuration shown on the plant and shall be fitted with manufactured screen to prevent intrusion of insects or birds into the vent piping.
4. The structure dimensions of the wetwell chamber and air vent shall be as shown on the Drawings.

2.2 RAW SEWAGE INFLUENT GRINDER PUMPS

A. Manufacturers:
1. Barnes
2. KSB
3. Ebara
4. ABS
5. Substitutions: Section 01600 - Product Requirements

B. General:
1. The sewage pumping units shall be vertical, non-clogging, centrifugal sewage pumps with bottom inlet and side discharge. The pumps shall be direct driven by integral squirrel cage, electric induction motors. Each pump shall include motor, bearings, quick removal system, anchor bolts and all accessories specified herein.
2. Pump Materials of Construction: Compatible with raw sewage.
3. Pump and motor produced by same manufacturer.

C. Power Cable:
1. Minimum 50 feet of submersible cable (SUBCAB) suitable for submersible pump applications, sized in accordance to NEC and ICEA standards and meeting P-MSHA approval.

D. Lifting Cable:
1. Minimum 30 feet per pump of stainless-steel cable capable of lifting loads 5 times greater than actual pumping unit weight.

E. Pump Design:

1. Pump designed to automatically and firmly connect to the discharge connection, guided by no less than two guide bars extending from top of station to discharge connection.
2. Provide intermediate guide brackets for installations greater than 20 feet.
3. Sealing of pumping unit to discharge elbow accomplished by machined metal-to-metal watertight contact.

F. Pump Construction:
1. Major pump components shall be grey cast iron ASTM A-48, Class 35, with smooth surfaces free of blow holes or other irregularities.
2. Exposed nuts or bolts of stainless steel construction.
3. Factory applied spray coating of acrylic dispersion zinc phosphate primer with polyester resin paint finish on exterior pump surfaces coming into contact with sewage.
4. Metal to metal contact sealing design on machined surfaces.
5. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings.

G. Cooling System:
1. Integral, closed-loop motor cooling system encircling stator housing providing for dissipation of motor heat, consisting of integral impeller driven by pump shaft.
2. Cooling system to include one fill port and one drain port integral to the cooling jacket.
3. Cooling system to provide continuous pump operation at liquid or ambient temperatures up to 104°F.
4. Collins systems utilizing sewage as a cooling fluid shall not be allowed.

H. Cable Entry Seal:
1. Dual cylindrical elastomer grommets, flanked by washers, all having close tolerance fit against cable outside diameter and entry inside diameter.
2. Grommets compressed by cable entry unit, providing strain relief function.
3. Cable entry junction chamber and motor sealed from each other.

I. Motor:
1. NEMA B, induction type with squirrel cage rotor, shell type design, housed in air-filled watertight chamber.
2. Stator windings insulated with moisture resistant Class F insulation rated for 180°C.
3. Stator insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in winding fill factor of no less than 95%.
4. Inverter duty rated in accordance with NEMA MGA, Part 31.
5. Stator heat shrink fitted into cast iron stator housing.
6. Motor designed for continuous duty while handling pumped media up to 104°F.
7. Motor designed to withstand no less than 15 evenly spaced starts per hour.
8. Rotor bars and short-circuit rings constructed of aluminum.
9. Three thermal switches embedded in stator end coils, one per phase winding to monitor stator temperature.
10. Junction chamber sealed from stator housing containing a terminal board for connection of power and pilot sensor cables using threaded compression type

terminals.

11. Motor service factor of 1.15.
12. Motor voltage tolerance of +/- 10%.
13. Motor designed for continuous operation up to 40°C ambient temperature with NEMA Class B maximum operating temperature rise of 80°C.
14. Motor horsepower sufficient for pump to be non-overloading throughout entire performance curve, from shut-off to run-out.
15. Motor and cable capable of continuous submergence underwater without loss of watertight integrity up to and including to a depth of 65 feet.

J. Bearings:

1. Integral pump/motor shaft to rotate on two bearings.
2. Motor bearings sealed and permanently grease lubricated with high temperature grease.
3. Two row angular contact ball bearing on upper motor bearing.
4. Two row angular contact ball bearing on lower motor bearing designed to handle both thrust and radial forces.
5. Minimum L_{10} bearing life of 50,000 hours at any useable point on the pump curve.

K. Mechanical Seals:

1. Provide pumps with positively driven, dual, tandem mechanical shaft seal system consisting of two seal sets, each with independent spring.
2. Lower primary seal, located between pump and seal chamber, containing one stationary and one positively driven rotating corrosion resistant tungsten-carbide ring.
3. Upper secondary seal, located between seal chamber and seal inspection chamber, containing one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring.
4. Provide pumps with lubricant chamber for shaft sealing system. Lubricant chamber designed to prevent overfilling and providing capacity for lubricant expansion. Lubricant chamber designed with one drain plug and one inspection plug accessible from exterior of motor unit.
5. Separate seal leak chamber capable of capturing leakage occurring past upper secondary mechanical seal prior to leakage entry into motor stator housing. Leakage chamber provided with float type switch that will signal if chamber reaches 50% capacity.

L. Pump/Motor Shaft:

1. Single piece unit, ASTM A479 S43100-T stainless steel.

M. Impeller:

1. ASTM A-48 Class 35 grey cast iron, dynamically balanced, non-clog design.
2. Mechanically self-cleaned automatically upon each rotation as passing across spiral groove located on volute suction.
3. Impeller leading edges hardened to Rc 45.
4. Impeller capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater.
5. Impellers shall be key driven and securely held to the shaft by a streamlined impeller washer and bolt assembly specifically designed to reduce friction in the

suction eye of the impeller. The arrangement shall be such that the impeller cannot unscrew or be loosened by torque from either forward or reverse rotation.

6. The impeller shall be capable of passing a 3-inch solid non-deformable sphere through the bottom inlet and out between the two shrouds. Designs which cannot pass a sphere through the impeller or rely on deforming, cutting or chopping solid materials shall not be acceptable.

N. Volute:

1. ASTM A-48, Class 35 single piece grey cast iron, with smooth passages of sufficient size to pass any solids entering impeller.
2. Volute to have integral spiral-shaped, sharp-edged grooves cast into suction cover.
3. Internal volute bottom shall provide effective sealing between the impeller and volute. All mating surfaces requiring a watertight seal shall be machined and fitted with Buna-n O-rings. Paper gaskets are not acceptable.

O. Discharge Base Elbow:

1. ASTM A-48, Class 35 grey cast iron, ANSI class 125 pound flange, coated with coal tar epoxy.
2. The discharge base elbow shall be provided to support the full weight of the submersible pump in the installation and provide a leak proof connection in which the pump coupling mates using a conformed Buna-N seal which is held in place by the combined weight of the cantilevered pump and motor. The hydraulic pressure generated while the pump is in operation also aids the sealing.

P. Guide Rails:

1. 304 stainless steel guide rails supported by upper and intermediate brackets of 316 stainless steel shall guide each pump.
2. The guide rails shall consist of standard dimension schedule 40 piping with a 2" diameter as shown on the drawings. The guide rails shall be supported by a 316 upper guide rail bracket that will be mounted in the opening of the access cover to support and guide the pump/motor into and out of the wet well. Intermediate guide rail brackets will be provided for all installations deeper than 20 ft.

Q. Operating Characteristics:

Pumping units as specified herein include units installed at the location(s) as shown on the Drawings. The design characteristics are summarized as follows:

Tertiary Cloth Media Filter - Lift Station

Design Conditions:	1050 GPM @ 14' TDH
Minimum Hydraulic Efficiency at Design Point:	50%
Electrical Service:	460 V/ 3Ø/ 60Hz
Motor Hp and Max. Speed:	10 Hp - 1150 RPM
Discharge Elbow Size:	6-inch

Packaged Granular Media and Resin Filter System - Lift Station

Design Conditions:	1050 GPM @ 39' TDH
Minimum Hydraulic Efficiency at Design Point:	75%
Electrical Service:	460 V/ 3Ø/ 60Hz

Motor Hp and Max. Speed:	20 Hp - 1150 RPM
Discharge Elbow Size:	6-inch

R. Pump Warranty:

1. Pump manufacturer shall warrant units supplied against defects in workmanship and materials for a period of five (5) years or 10,000 hours under normal use, operation and service. Warranty period to extend from date of start-up.

2.3 PUMP CONTROLS

A. Refer to Specification Section 16480 ("Manufactured Control Panels") for additional control panel requirements.

1. The following pump control panels shall be provided with the pumps by the pump supplier and shall consist of the following components:
   a. Cloth Media Filter Influent Lift Station
      1) Voltage 480V 3-Phase-3Wire
      2) Main Breaker sized by pump supplier.
      3) Overload and short circuit protection for each pump.
      4) Integral 120V Control Power Transformer as required.
      5) Circuit breakers for Control power and GFCI Outlet (mounted inside control panel).
      6) Pump Controls as summarized below.
   b. Cloth Media Filter Effluent Lift Station
      1) Voltage 480V 3-Phase-3Wire
      2) Main Breaker sized by pump supplier.
      3) Overload and short circuit protection for each pump.
      4) Integral 120V Control Power Transformer as required.
      5) Circuit breakers for Control power and GFCI Outlet (mounted inside control panel).
      6) Pump Controls as summarized below.
2. Electrical
   a. Refer to electrical plans for panel short circuit ratings and other similar electrical requirements.
   b. All breakers shall be mounted such as to be accessible from the outside of the dead front panel without requiring the operator to be exposed to live/energized parts.
   c. All circuit breakers shall be heavy duty thermal magnetic or motor circuit protectors similar and equal to SQUARE D type FAL.
3. The control panels shall consist of the following components.
   a. Hand-Off-Automatic switch for each pump.
   b. Red high level tamper resistant LED alarm light with steady and flash circuits.
   c. Thermal motor protection circuit.
   d. Solid state cross wired alternator with pump isolation switch.
   e. Circuit breaker protection capable of full panel operation with interlocked handle.
   f. Circuit breaker for each pump.
   g. Pump seal fail and overtemperature monitoring relay for each pump.
   h. Pump run green LED pilot light for each pump.

i. Phase converter (PC) variable frequency drive (VFD) starter/contactor for each pump.
j. Overload reset button.
k. Run time hour meters.
l. Lightning arrestor installed as per the drawing.
m. Amber overload trip LED pilot light for each pump.
n. Amber seal fail LED pilot light for each pump.
o. Amber motor overtemperature LED pilot light for each pump.
p. 15A GFCI convenience outlet mounted on inner door.
q. All pilot devices shall be oil tight NEMA 4X rated. Indicator lights shall be push-to-test.
r. SCADA dry contacts for:
    1) Power Loss Alarm.
    2) High Level Alarm
    3) Alarm (overload, seal failure, over-temp) for each pump.
    4) Pump running for each pump.

2.4 LIQUID LEVEL CONTROL:

A. A set point microprocessor-based level controller shall be provided to control the operation of the pumps in each station. For the purpose of establishing a minimum standard of performance and quality, the controller shall be manufactured by Primex, MJK, or approved equal. Other level controllers will be considered only if they are pre-submitted for approval in accordance with these Specifications. The level control will be mounted in the pump control panel as specified above, and shall be completely wired and tested prior to shipment. The manufacturer of the liquid level control system shall be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. The level control system shall automatically start and stop the pumps in response to sensed changes in wet well level, as set forth herein. The level control system shall utilize a submersible transducer for primary level control, but shall also be provided with a backup float system.

C. A microprocessor-based pump controller shall be provided in the panel to receive a single analog process variable input signal and provide user-selectable pump-down control. The controller shall be user-configurable for simplex, duplex, or triplex operation. The liquid level controller shall be manufactured by Primex, MJK, or approved equal.
    1. The controller shall be an off-the-shelf, preprogrammed unit, dedicated to pump control functionality. Non-standard controller designs that incorporate one of a kind or custom-programmed generic PLCs do not meet the intention of these Specifications for standard, modular product design, and will not considered acceptable.
    2. The level controller shall be a standard production item of the control panel manufacturer.

D. The operator interface shall consist of a text/graphical display, dedicated alarm and pump status indicators, operator navigation buttons, and a rotary selector wheel providing intuitive navigation. The display shall be capable of showing all alarm and status information as well as configurable parameters.

1. The operator interface shall have a display area of not less than 2.7", with 64x256 pixel resolution.
2. The display shall be based on OLED technology, offering increased energy savings and wide viewing angles.
3. The controller shall be configured with a main (home) display that shows the analog process variable in engineering units and as a dynamic vertical bar graph. The process variable display shall contain up to four digits with a decimal place. The main display shall also provide indication of lead pump, active alarm indication, and shall show the most current active alarm text message.

E. The level controller shall be provided with predefined inputs and outputs having a total I/O compliment of eleven (11) discrete inputs, six (6) discrete outputs, one (1) analog input, and one (1) analog output.

F. The level controller shall be capable of accepting the following inputs as a minimum:
1. Pump 1, 2 running or disabled (selectable)
2. Pump 1, 2 seal failure
3. Pump 1 2 overtemperature
4. High level float
5. Alarm horn silence/reset

G. The level controller shall provide outputs for pump activation and alarms. Outputs shall be contact closures rated for 250VAC @ 3 amps. The level controller shall be capable of providing the following outputs as a minimum:
1. Pump 1, 2 call
2. Common alarm (i.e., horn and/or light)
3. High level
4. Low level

H. The level controller shall monitor a 4-20 ma input signal representing the process variable, and shall have 14-bit resolution (or higher). The controller shall include a 24VDC power supply for powering an external loop-powered transmitter, and shall provide a 4-20 ma output that is scalable to reflect the process level. The output resolution shall be fully scalable and not less than 12 bit.

I. The packaged lift stations shall be provided with complete electrical control panels as outlined herein, or as shown on the Drawings. The panels will be designed to automatically control the operation of the Tertiary Cloth Media Lift Station pumps, as well as the Packaged Granular Media and Resin Filter System Lift Station pumps, as outlined above and described herein. Multiplex panel configuration shall be provided in accordance with the number of pumps being controlled. The operation of the lift stations control panel shall be based upon starting pumps based on high level, and stopping them based on low level in the wetwell. High-level and low-level alarms shall also be indicated on the panel exterior.
1. The control system for the lift stations shall be designed to attain operation as specified herein. The control panel, regardless of the mode of operation selected, shall provide indication of low level and high level by means of front-mounted pilot lights, as well as an externally-mounted alarm light as specified herein. The anticipated sequence of operation of the controls shall be as follows:

a. Normal system operation shall be to start the lead pump motor when the sensed wetwell level rises to the desired "lead pump start" set point. The lead pump shall run until the wetwell level reaches the desired "pump stop" point, at which point the lead pump shall be stopped.

b. Should the first pump not be able to satisfy demand and the wetwell level continues to rise, the lag pump motor shall be started when wetwell level reaches the "lag pump start" set point. Both pumps shall operate until the wetwell level reaches the "pump stop" set point, at which point both pumps shall be stopped.

c. After a pump is stopped at the low wetwell level setting, an off-delay will hold the pump starter (s) for a short, adjustable length of time to allow the system to compensate for any air that may be absorbed into the water. The "off" delay shall be fully adjustable over a range of 0-30 seconds. Off delay timers shall be provided for both pump circuits.

d. Additional level set points shall be provided to indicate high and low system pressure. Should either of these conditions be sensed, a door-mounted pilot light and the external alarm light shall be energized, so that operating personnel can make corrections to the system as required.

2. Tertiary Cloth Media Filter pumps shall be controlled as outlined above, synchronized with the operation of the Packaged Granular Media and Resin Filter System pumps as described.

3. A level transducer shall be provided as outlined herein, for installation by the contractor in the position indicated on the Drawings, or as directed by the Engineer. The pump controller shall be capable of handling multiplex pump operation based on the incoming signal from the transducer. The use of individual pressure switches for pump control shall not be allowed.

4. Pump operating sequence shall be alternated after any of the two pumps is called for to run, so that unit operating hours are equalized. A 0-24 hour time clock shall be provided to automatically advance the alternation sequence after an adjustable length of time

J. The level controller shall have a built-in intuitive menu structure that allows quick and easy navigation and access to system data, status and adjustment of operator-configurable parameters for system automation. The controller shall limit operator adjustments to only the active components of the system. The controller shall allow system viewing and configuration of the following status and parameters:

1. When editing alteration, the display shall show only the active pumps to prevent the sequencing of unavailable pumps. Alternation schemes shall include operator selection of a fixed pump sequence and/or automatic alternation mode to equalize pump wear. The alternator shall also have the capability of being put into a fixed sequence mode at any time.

2. When editing the level set points, the display shall show the available level range to prevent adjustments outside the operating range of the systems. The controller shall allow the operator to establish pump on/off level set points for each active stage (lead and lag pump), as well as high and low level alarm levels desired.

3. The level controller shall monitor and accumulate the following data:
   a. Starts for each pump (operator resettable to zero)
   b. Elapsed run time for each pump
   c. High level alarm occurrences (resettable to zero)
   d. Low level alarm occurrences (resettable to zero)

e. High level/backup float alarm occurrences (resettable to zero)

4. The level controller shall allow for level simulation via the front panel display. The simulation shall allow the operator to simulate wet well level and verify that operating parameters are working as intended and programmed.
5. The level controller shall allow for configuration of the process variable input received from the external level/pressure transmitter. The controller shall allow the following operator adjustments:
   a. Allowable transducer range shall be not less than 0-999.0
   b. The process input shall be viewable as inches, feet, or PSI
   c. Level offset shall allow the operator to compensate for the actual transducer/level transmitter placement, with an allowable range of not less than 0-999.9
6. The controller will allow for operator selection of pump up (fill) or pump down (empty) modes of operation.
7. The controller shall be operator-configurable to limit the number of pumps allowed to operate at one time.
8. Pump on delay adjustment (0-250 seconds) shall allow for the time between pump starts. The set time shall provide staggered starting of the pumps based on the set time. Setting the time to zero will allow all pumps to turn on at the same time when required by level input.
9. Pump off delay adjustment (0-250 seconds) shall allow for the time between pump stops. The set time shall provide staggered stopping of the pumps based on the set time. Setting the time to zero will allow all pumps to turn off at the same time when required by level input.
10. Set point dwell time adjustment (0-99 seconds) shall be provided to prevent nuisance pump operation or alarm activation based on momentary fluctuations of the input signal, or to allow for temporary process variable swings from affection system operation.
11. Motor/pump failure to start delay shall be provided and shall be operator-adjustable (0-99 seconds). This parameter shall be active when the level controller is monitoring eternally produced pump/motor run signals. When active, the controller shall determine pump failure to start when the external run input is not present after the adjustable time delay. If the motor fails, an alarm shall be produced and displayed.
12. A station data display shall be provided, allowing operator entry of the station's basic design parameters. As a minimum, the following parameters shall be displayable:
    a. Pump horsepower
    b. Pump voltage
    c. Pump full load amperage
    d. Tank (wet well) diameter, if applicable

K. The level controller shall monitor pump status and alarms as follows:
1. The level controller shall allow for monitoring of external switches indicating "pump run" or "pump disable". The function shall be operator-selectable.
   a. In the "run feedback" selection, the controller shall use this input for monitoring "motor start" and determining "motor failure to start" alarms. When activated, the operator-mounted pump run indicator light shall be illuminated.

b. In the pump disable mode, the controller shall prevent the associated pump from running.

2. The controller shall monitor pump seal failure. The input shall detect a contact closure from an external pump protection module or be able to monitor the seal probes directly. When active, an alarm shall be produced, but the motor shall continue to operate.
   a. The seal fain monitoring shall be operator-selectable for normal or inverted operation.
3. The level controller shall monitor pump/motor overtemperature. The input shall detect a contact closure input from an external source. When the overtemperature input is activated, an alarm shall be produced and the motor call signal shall be disabled until the condition is cleared.
   a. The level controller shall be configurable for automatic return to operation when the condition clears, or require manual reset before allowing the pomp./motor to restart.

L. The level controller shall be provided with built-in diagnostics to facilitate on-site user troubleshooting. The controller shall support the following diagnostics:
1. Digital input open/closed status
2. Relay output on/off status
3. Analog input raw input signal in mA
4. Analog output signal in mA

M. Two (2) backup float switches (specified elsewhere in these Specifications) will be provided to initiate the backup control system. Float switch operating levels shall be field-set at elevations above the controller high level alarm set point.

N. The level controller shall operator on a 24VDC power source. Controller will be able to operate in an environment with 5-95% humidity non-condensing, and shall have a temperature operating range of hot less than 0 - 122 degrees F.

O. One (1) spare level controller shall be provided as a spare, as outlined elsewhere herein. The local representative shall also maintain a stock of the specified level controllers for backup purposes.

2.5 SUBMERSIBLE TRANSDUCER:

A. One analog submersible level transducer shall be supplied with each control panel. The transducer shall be designed to provide a 4-20 milliamp level signal proportional to the sensed liquid level in the wet well. The unit shall be sealed and non-fouling design, and shall be provided flush-mounted abrasion resistant Kynar diaphragm. Level sensor shall be a submersible level transducer by KPSI, MJK or approved equal, with 316 stainless-steel protective spacer, Mercoid 316 stainless-steel bird cage, or approved equal. One spare transducer/cable assembly shall be provided as a spare part.

B. The submersible hydrostatic level transducer shall be provided with a large diameter elastomeric diaphragm and protective cage specifically designed to meet adverse environments encountered in wastewater applications. The transducer shall feature a wide sensing area comprised of a PTFE coated elastomeric diaphragm for reliable operation in highly viscous or slurry environments. The transducer assembly shall be integrated with

all required supporting electronics mounted within a durable waterproof housing constructed of welded 316 stainless steel or titanium.

C. Polyurethane or Tefzel electrical cable shall be provided, manufactured to MEAS specifications, and shall include Kevlar members to prevent errors due to cable elongation, as well as a unique water block feature that self-seals in the event of accidental cuts to the cable. The transducer shall be vented to atmosphere by means of tubing contained within the included cable, and shall be shipped with the transducer manufacturer's latest-design super-dry vent filter that prevents moisture from entering the vent tube for a minimum of one year without maintenance, even in the most humid environment. Not less than two (2) spare vent filters shall be provided as specified herein.

D. Adequate cable shall be provided to allow installation of the transducer without need for splices in the cable between the wet well and the control panel location. Excess transducer cable shall be neatly coiled in the bottom of the control panel enclosure, and under no circumstances shall transducer cables be cut off in the field.

E. A built-in lightning arrestor shall be included to provide protection against transient voltage spikes. Lightning-protected models shall include both internal and external panel-mounted devices for maximum protection against surges, spikes and lightning. The transducer shall be provided with a two-year warranty against defects in materials and/or workmanship.

F. The transducer shall be a non-fouling design, and shall be provided with a wide-mouth protective cage to prevent damage to the diaphragm by debris in the wastewater. The cage shall also be constructed of 316 stainless-steel or titanium, and shall include spacers and a lower protective plate for protection of the sensing element and diaphragm. The transducer shall be capable of +/- 0.25% full scale static accuracy, and +/- 0.0001% full scale resolution, and shall be available in custom level ranges of up to 115 feet (35 meters). Level range provided shall be specifically selected for this project, based on the wet well depth as shown on the Plans.

G. Analog output from the transducer shall be 4-20 mA. Excitation voltage shall be provided by the level controller specified herein, and the transducer and controller shall be matched to provide for accurate, repeatable operation for years. Operating temperature range shall be from -4 to +140 degrees Fahrenheit.

H. An aneroid bellows constructed of flexible neoprene material shall be attached to a polycarbonate mounting bracket inside the control panel enclosure, and shall be properly applied to result in a closed reference pressure system subject to zero shift errors induced by changing temperatures of up to 0.003 PSI per degree Celsius. One spare bellows shall be provided as a spare part.

I. A woven wire cable hanger shall be provided by the transducer manufacturer to allow suspension of the transducer in the wet well. The hanger shall be fabricated of 316 stainless steel, and shall provide a looped connection to suspend the transducer. Hanger shall be a regular production and cataloged item of the transducer manufacturer, and shall be specifically designed for use with the specified equipment.

J. One spare transducer/cable assembly, two vent filters, and one spare bellows shall be provided as spare parts.

2.6 BACKUP FLOAT CONTROLLER:

A. A modular backup controller shall be furnished and installed on the inner door of the pump control panel, to provide a means of pump operation in the event that the primary level control and/or submersible transducer fail. The backup controller shall be a multi-function controller designed to operate two or three pumps by Primex, MJK or approved equal. The microprocessor-based pump controller shall be provided to monitor wet well level via multiple float switches and control two or three pumps in a pump-down application. The pumps shall start and stop as required to maintain an acceptable level.

1. The controller shall be mounted on the control panel's inner door. Terminals shall be located at the back of the controller for easy connection and module replacement. The terminals shall be touch safe and clearly labeled for easy identification. Terminal strips shall plug into the back of the control module for easy and quick replacement if required.

B. The backup level control system shall automatically start/stop the pump motors in response to sensed changes in the wet well levels, as set forth herein and below:

1. When the "stop" and the "start" float switches are activated, the lead pump shall start and run. If the capacity of the lead pump is greater than the sump inflow, the lead pump shall stop when the level reaches the "stop" float switch.
2. If the capacity of the lead pump is less than the inflow, the lag pump shall be called to start as the level rises above the "start lag" float switch. If the capacity of both pumps running in parallel is greater than the sump inflow, both pumps will continue to run until the level reaches the "stop" float switch.
3. The pumps shall operate in the pumping sequence if manually selected or shall alternate after each complete operating cycle if alternation is enabled.
4. Float switch settings shall be such that the backup float controller does not conflict or interfere with the performance of the primary level controller and submersible transducer as specified above.

C. The pump controller shall be an off-the-shelf, pre-programmed, and application-specific microprocessor based controller capable of accepting inputs from multiple float switches, and automatically control the operation of one to three pumps by Primex, MJK or approved equal. PLC systems utilizing one of a kind, non-standard, custom programming generic controllers represent additional complexity and unproven operation are not in conformance to the intent of these specifications, and will not be acceptable.

D. The operator interface (HMI) shall consist of a text/graphical display, dedicated alarm and pump status indicators, operator navigation buttons and rotary selector wheel providing quick and easy system navigation. The display shall be capable of showing all system status and configurable parameters as herein defined.

1. The operator interface shall have a display area not less than 2.7" with 64 x 256 pixel resolution.
2. The display shall be based on OLED technology offering increased energy saving and wide viewing angles.

E. The controller shall be configured with a main level (home) display that indicates the status of each float switch and pump with dynamic updates based on sensed level changes in the wet well. The level display shall have the ability to show pump run times, pump cycles, pump currents (amperage) and pump discharge flow. The main display shall provide

indication of lead pump, active alarm indication and show the most current active alarm text message.

1. When Modbus communication is activated, the main level display will include a "communication active status" indicator confirming recent connection to a master device.

F. The standard controller shall be provided with predefined inputs/outputs as specified herein, and having a total I/O compliment of eleven (11) discrete inputs, six (6) discrete outputs, one (1) analog input, and one (1) analog output. As a minimum, in the base configuration, the controller shall be capable of accepting the following input status signals:

1. Pump 1, 2 running
2. Pump 1, 2 fault
3. Transducer Level
4. Float 1
5. Float 2

G. The controller shall provide outputs for pump operation and alarm signals. Outputs shall be contact closures, each rated at 120 VAC @ 3 amps. As a minimum, in the base configuration, the controller shall be capable of providing the following output signals:

1. Pump 1, 2 call to run
2. High level alarm
3. Programmable relay #1
4. Programmable relay #2

H. Programmable relays shall be selected via the menu for the following:

1. General alarm
2. High float alarm
3. Low float alarm
4. Pump 1/2/3 general fault
5. Pump 1/2/3 run
6. Auxiliary alarm
7. Pump clog/dry run
8. Float failure
9. Maximum cycle time
10. Maximum fill
11. Low amperage
12. High amperage

I. The controller shall also be capable of monitoring a 4-20 mA signal input if needed. The analog input shall have 14-bit resolution or higher, and be configured to monitor pump current or discharge flow. The controller shall also include a built-in 24VDC power supply for powering an external loop powered process transmitter.

1. The controller shall provide a 4-20 mA output that is scalable to retransmit the analog input value, or a step output of level based on the status of the float switches. The output signal shall be fully scalable and not less than 12-bit resolution.

J. The controller shall be provided with a built-in intuitive menu structure that allows quick/easy navigation and access to system data/status, and adjustment of operator configurable parameters for system automation. The controller shall limit operator

adjustments to only the active components of the system. The controller shall allow system viewing and configuration of the following status and parameters:

1. When editing the alternation, the display shall show only the active pumps to prevent sequencing of unavailable pumps
2. Operator selection of a fixed pump sequence or automatic alternation mode to equalize pump wear.
3. The alternator shall have the capability of being put into fixed sequence mode at any time.

K. Up to ten (10) different float switch configurations shall be available, including:

1. Select the number of float switches used in the system
2. Select the type of pump operation in the system (demand or timed dosing)

L. The modular controller shall monitor and accumulate the following items:

1. Motor/pump starts for each motor/pump (operator resettable to zero)
2. Motor/pump accumulated run time for each motor/pump
3. High level alarm occurrences (operator resettable to zero)
4. Low level alarm occurrences (operator resettable to zero)
5. Pump fault(s) occurrences (operator resettable to zero)
6. Pump low amp occurrences (operator resettable to zero)
7. Pump high amp occurrences (operator resettable to zero)

M. The controller shall allow for level simulation via the front panel display. Simulation shall allow the operator to simulate float switches operation sequentially, and verify that operational parameters are working as intended.

N. The controller shall allow the following operator adjustments:

1. The controller shall allow for the operator selection of the number of active pumps. The controller shall be easily set for 1 or 2 pumps.
2. The controller shall be operator configurable to limit the number of pumps allowed to operate at any given time.
3. Pump on delay adjustment (0-250) shall allow time (in seconds) between pump starts. Set time will provide stagger starting of the pumps based on the set time value. Setting the time to 0 (zero) will allow all pumps to turn on at the same time.
4. Pump off delay adjustment (0-250) shall allow time (in seconds) between pump stops. The set time will provide stagger stopping of the pumps based on the set time value. Setting the time to 0 (zero) will allow all pumps to turn off at the same time.
5. Float detect time (adjustable, 1-30 seconds) shall be provided to prevent nuisance pump operation or alarm activation based on water turbulence or electrical noise.
6. The controller shall be configurable to alarm if the pump run cycle exceeds the “maximum cycle time” preset value entered in the configuration.
7. The controller shall be configurable to detect a pump failure when the next pump in the alternation sequence is started as the “lag” pump three times in a row. This shall be an indication that the “lead” pump is not performing optimally, and shall trigger a “pump clog alarm”.

O. The backup controller shall detect float failure by analyzing the operating sequence of each float switch and determine malfunction or hang-up. The controller shall lock out and alarm

a faulted float switch and re-assign the operation of the station to the other floats until it is replaced.

P. A station data display shall be provided allowing operator entry of the stations basic design parameters. As a minimum the following parameters shall be displayable:
   1. Pump horsepower
   2. Pump voltage
   3. Pump FLA

Q. The controller shall monitor pump status and alarms as follows:
   1. The controller shall allow for monitoring of external switches indicating pump run. Inputs on the controller shall monitor motor starts and run times. When activated the operator mounted pump run indicator light shall be illuminated.
   2. The controller shall also monitor pump fault. The input shall detect a contact closure input from a motor starter overload trip contact and from a pump thermos-switch contacts or pump protection modules when used. When the input is activated, an alarm will be generated, and the motor call signal will be disabled until the condition is cleared.
   3. The controller shall be configurable for automatic return to operation when the condition clears or require manual reset before allowing the pump/motor to restart.

R. The controller shall operate on 24VDC power source. Controller shall be able to operate in an environment between 5–95% humidity non-condensing and have a temperature operating range of not less than 0 to 122 Deg. F.

S. One (1) spare backup controller shall be provided as a spare part.

2.7 BACKUP FLOAT SWITCHES:

A. Backup control level float switches shall be supplied with the pump control panel, for installation by the contractor as shown on the Plans or as directed in the field. Four (4) floats shall be provided for pump “off”, pump #1 start, pump #2 “start”, and high level alarm. Each float switch shall be provided with adequate cable length to reach the control panel without splicing. Switches shall be the direct-acting type, designed and constructed for extremely long life in severe applications, and shall contain a single pole mercury switch in the normally open position, and which shall close when the switch body is tilted. Switches provided shall be epoxy encapsulated, and the level sensors shall be impact and corrosion resistant.

B. Float switch housings shall be 316 S.S., and shall be provided with a Teflon coating to reduce the buildup of fat, oil, grease and other materials. #14/3 AWG Hypalon-jacketed Type SO cable shall be provided with each float switch, of the length as noted herein, or as necessary for installation on site. Cable shall have a minimum of 105 strands of copper in each conductor for maximum flexibility. A green ground wire shall also be included in the cable for each float switch, and shall be connected to the ground terminals in the pump control panel. Float switch contacts shall be rated for 20 amps @ 120VAC.

C. Each float switch shall be provided with the necessary hardware to enable it to be securely mounted on a 1/8" diameter 316 S.S. mounting cable. A suitable weight kit shall be attached to the bottom of the float switch suspension cable to secure both the cable and the

float in the wet well, and to prevent excessive movement. The float switch connection hardware shall be adjustable to allow repositioning in the wet well as required. The entire float assembly (weight, support cable, and all switches) shall be easily removed from the wet well for inspection, cleaning, or adjustment as required. Mounting hardware shall be included for installation of the float switches on the support cable assembly.

D. Float switches shall be manufactured by Anchor, MJK or approved equal. A suitable 304 stainless-steel support bracket shall be provided to secure the float switch cables at the top of the wet well.
   1. One (1) spare float switch shall be provided as a spare part.

2.8 SPARE PARTS AND EQUIPMENT:

A. After installation and startup of the pump station, the manufacturer(s) shall provide the following spare parts/equipment to the Owner for use during normal operation and/or maintenance:
   1. Four (4) complete sets of pump packing
   2. Four (4) spare ice cube relays
   3. Two (2) spare timing relays
   4. One (1) complete level controller module
   5. One (1) complete level transducer with cable
   6. Twelve (12) pilot light lamps
   7. One (1) spare float switch

B. All spare parts shall be provided packed in suitable containers for extended storage by the Owner after startup. Any spare parts consumed during equipment startup shall be replaced by the manufacturer without cost to the Owner.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Verify layout and orientation of pumps, accessories, and piping connections.

3.2 INSTALLATION

A. Install pumps where indicated on Drawings and in accordance with manufacturer's instructions.

B. Provide and connect piping, power and control conduit and wiring to make system operational, ready for startup.

C. Flush piping with clean water.

3.3 FIELD QUALITY CONTROL

A. Section 01700 - Execution Requirements.

B. Pre-operational Check: Before operating system or components, make the following checks:
   1. Check pump and motor alignment.
   2. Check for proper motor rotation.
   3. Check pump and drive units for proper lubrication.

C. Start-up and Performance Testing:
   1. Operate pump on clear water at design point for continuous period of two hours, under supervision of manufacturer's representative and in presence of Engineer.

D. Verify pump performance by performing time/draw down test.

E. Check pump and motor for high bearing temperature and excessive vibration in accordance with the manufacturer’s recommendations. Check for motor overload by taking ampere readings.

F. Equipment Acceptance:
   1. Adjust, repair, modify or replace system components that fail to perform as specified and rerun tests. Make final adjustments to equipment under direction of manufacturer's representative.

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 01400 - Quality Requirements.

B. Furnish services of manufacturer's representative experienced in installation of products furnished under this specification for not less than one eight-hour day on-site for installation inspection and field testing, and instructing Owner's personnel in maintenance of equipment.

C. Certify that equipment has been properly installed and is ready for start-up and testing.

3.5 DEMONSTRATION

A. Section 01700 - Execution Requirements.

B. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner’s personnel.

END OF SECTION

SECTION 11251

ELECTRIC VALVE ACTUATORS

PART 1 GENERAL

1.1 SUMMARY

A. Description:
   1. The Contractor shall furnish, install, test and place in satisfactory operation, quarter-turn electric valve actuators complete with electric motor, position and torque sensors, manual handwheel override capability, controls, and all accessories and features as shown on the Plans and specified herein, for a complete and operable system.

B. Related Sections:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 REFERENCES

1. AWWA Standard C542

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Shop Drawings:
   1. Submit detailed dimensions for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and all other details.
   2. Descriptive literature, bulletins, and catalog cuts of all equipment components to indicate full compliance with these specifications.
   3. Complete bill of materials for all components.
   4. Complete information concerning materials of construction and fabrication demonstrating compliance with these specifications.
   5. Complete spare parts list.

C. Product Data: Submit information concerning materials of construction and fabrication.

D. Manufacturer's Installation Instructions: Submit detailed instructions on installation and configuration requirements including storage and handling procedures, electrical connection, controls setup, anchoring, and layout.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

F. Other Information: Technical manuals, parts list, warranty information, equipment storage recommendations.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories. Record initial settings and parameters for controls equipment.

C. Operation and Maintenance Data:
   1. Submit operation and maintenance (O&M) manuals for all equipment and accessories supplied. Prepare O&M manuals specifically for this installation and provide all cuts, as-built drawings, equipment lists, spare parts lists and sources, manufacturer's recommended preventative maintenance procedures, troubleshooting recommendations, descriptions, etc, that are required to instruct operation and maintenance personnel unfamiliar with such equipment. Include as-built control and electrical diagrams.
   2. Include all manufacturer's data provided in the initial submittal.
   3. Provide list of equipment and tools required to maintain and calibrate equipment.
   4. Provide manufacturer's certification that all equipment has been installed in accordance with manufacturer's instructions.
   5. Provide fully executed warranty document.
   6. Furnish one (1) hard copy of O&M manual in three-ring binder, and electronic copy in .pdf format. Provide minimum of two (2) laminated electrical and control wiring diagrams based on as-built conditions on maximum 11" x 17 sheets.

D. Special Tools: Provide two (2) sets of any special tools required for proper maintenance of all equipment.

E. Spare Parts: Provide spare parts properly bound and labeled for easy identification without opening packaging and suitably protected for long-term storage.

F. Manufacturer's Field Reports: Following performance testing, certify that equipment has been installed in accordance with manufacturer's instructions, and that all systems have been installed properly and are functioning correctly.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Owner's standard.

B. Maintain one copy of each document on site.

C. Actuator and associated valve shall be provided by the same supplier.

1.6 PRE-INSTALLATION MEETINGS – **NOT REQUIRED**

A. Section 01300 - Administrative Requirements.

B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements.

B. Inspect for damage.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces. Store and handle products in accordance with manufacturer's recommendations.

1.8 SEQUENCING

A. Section 01100 - Summary.

B. Sequence work to prevent interference with Owner's operations.

1.9 SCHEDULING

A. Section 01300 - Administrative Requirements.

B. Schedule work to prevent interference with Owner's operations.

1.10 COORDINATION

A. Section 01300 - Administrative Requirements.

B. Coordinate start-up, performance testing, and demonstration with Owner and Engineer. Provide minimum of one week's notice.

1.11 MAINTENANCE MATERIALS

A. Section 01700 - Execution Requirements.

B. Furnish special tools and equipment required for maintenance, repair, and adjustment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Electric motor actuators with torque output requirements of 750 ft-lbs and less for butterfly valves and eccentric plug valves shall be quarter-turn type and shall be Rotork "IQT" Series or Auma SQ.

B. Other electric motor actuators for open-close, modulating or explosion proof service shall be intelligent multi-turn type and shall be Rotork "IQ" Series or Auma SA.

C. All actuators on the project shall be of one manufacturer.

2.2 ACTUATOR TAGGING

A. Provide identifying tags for electric motor-actuated valves. Show valve actuator tag number, name or designation as shown in the drawings, and valve size. Attach tags to actuators by means of stainless steel wire.

2.3 MOTORS FOR ELECTRIC ACTUATORS

A. Motors shall be 480 volt/3 phase as called for in the schedule contained herein; specifically designed for high torque, low inertia duty. Motors for on/off, open/close actuators shall be designed and rated for 15-minute duty or 60 starts per hour at 104°F. Motors and starters for modulating actuators shall be designed for 30-minute duty or 600 starts per hour at 104°F.

B. Output capacity shall be sufficient to open or close the valve against the maximum differential pressure when the voltage is 10% above or below normal at the specified service conditions. Motors shall have Class F insulation. Provide motor with torque output (at duty rating) that exceeds the requirements of paragraph E below including safety factor.

C. Provide an electrical and mechanical disconnection of the motor without draining the lubricant from the actuator gear case.

2.4 ACTUATOR TORQUE REQUIREMENTS

A. Actuators being installed on existing valves shall include the manufacturer's inspection, field testing and evaluation of the existing valve in order to apply the applicable torque requirements in order to properly actuate the existing valves.

B. The rated output torque of the motor actuator shall be at least 1.5 times the maximum torque required to open or close the valve at any position including seating and unseating conditions when subjected to the most severe operating condition including any mechanical friction and/or other restrictive conditions that are inherent in the valve assembly. Do not include hammer-blow effect in sizing the actuator to comply with this torque requirement. Coordinate with the valve manufacturer to assure that the motor actuator stall torque output does not exceed the torque limits of the valve operating stem or shaft.

C. Maximum torque shall include seating or unseating torque, bearing torque, dynamic torque, and hydrostatic torque. Assume that the differential pressure across the valve is equal to the pressure or head rating of the valve.

D. Assume a maximum pipeline fluid velocity of 10 fps with the valve fully open, unless a higher velocity is specified in the detailed valve specification.

2.5 DESIGN OF ELECTRIC MOTOR ACTUATORS

A. Actuators shall comply with AWWA C542, except as modified herein. Output capacity of motors shall be sufficient to open or close the valve against the maximum differential pressure when the voltage is 10% above or below normal at the specified service conditions. Provide motor with torque output (at duty rating) that exceeds the requirements of the following paragraphs including safety factor.

B. Provide a reversing starter, three overloads (one in each ungrounded leg) or two motor thermal cutouts, 120-volt control power transformer, local-off- remote selector switch, stop-open-close push buttons, and open and closed indicator lights. Provide magnetic starters in actuators for open/close operation and for modulating operation. Provide dry contact for remote indication of the actuator mode of operation. The contact shall be closed

when the local-off-remote selector switch is in the remote position and the internal control power exists.

C. Do not use external conduit for wiring any components within the actuator.

D. Assume a maximum pipeline fluid velocity of 10 fps with the valve fully open, unless a higher velocity is specified in the detailed valve specification.

E. Gear actuators shall be totally enclosed and factory-grease packed or oil- bath lubricated. The power gearing shall consist of helical gears of heat- treated steel. Worm gears shall be alloy bronze accurately cut with a hobbing machine. Worm shall be hardened steel alloy. Design gears for 24- hour continuous service with an AGMA rating of 1.50.

F. Position switches shall be adjustable and capable of actuation at any point between fully opened and fully closed positions. The position switches shall operate while the actuator is either in manual or in motor operation. Provide motor actuators with position switches capable of being separately used to provide remote indication of end of travel in each direction and to stop motion at the end of travel in each direction.

G. Provide two individually adjustable torque switches to protect the valve and motor against overload in the opening and closing directions. To prevent hammering, the torque switch shall not reclose until the valve is made to travel in the opposite direction.

H. Provide a manually operated handwheel that shall not rotate during electrical operation. In the event electrical power is interrupted, handwheel operation shall be activated by a hand lever attached to the mechanism. While the valve is being operated manually, the motor shall not rotate. Upon restoration of electrical power, the handwheel shall automatically disengage. Design the handwheel diameter such that hand operation will not damage the valve.

I. The position switch and torque switch contacts shall be capable of interrupting at least 0.2-ampere inductive load at 125-volt dc or 6-ampere inductive load at 120-volt ac.

J. Provide a lost motion device for open/close operation to permit the motor to reach full speed before the load is applied. Provide lost motion action for manual operation also. Do not provide lost motion device for modulating applications.

K. “Latching” shall be provided to inhibit high torque during unseating or starting in mid-travel against high inertia loads. The actuator electrical diagram shall be identical, regardless of whether the valve is to operate on torque or position limit. Provide the actuator with means to non-intrusively calibrate torque or position and interrogate the status and performance of the actuator.

L. Motor shall de-energize in the event of a stall when attempting to unseat a jammed valve.

M. Provide a time delay to prevent instant reversal of the actuator motor.

N. Provide terminal connections for external remote controls fed from an internal 24-volt or 120-volt supply.

O. Provide two separate 3/4-inch conduit connections for control and power wiring.

2.6 LOCAL ACTUATOR CONTROL

A. Integral to the actuator shall be local controls for Open, Close, and Stop, and a local/remote selector Switch:

1. Open/Stop/Close Push Buttons

2. Local/Off/Remote Selector Switch

B. All the necessary wiring, indication relays and terminals shall be provided in the actuator to accommodate the remote mounted push button control functions. Provide terminal connections for external remote controls fed from an internal 120-volt AC supply.

C. The following Control, Status and Alarm indication shall be available locally at the actuator:

Controls:	**Status:**	**Alarms:**
1. Open/Stop/Close 2. Desired Valve Position Control	1. Motor Running Open Direction 2. Motor Running 3. Fully Open 4. Fully Closed 5. Percentage Open	1. Actuator Alarm 2. Valve Alarm 3. Battery Low Alarm, if required

D. The actuator must provide a local display of the position of the valve, even when the power supply is not present. The display shall be able to be rotated in 90 degree increments so as to provide easy viewing regardless of mounting position.

E. The actuator shall include a digital position indicator with a display from fully open to fully closed in 1% increments with +/- ½% accuracy. Red, green, and yellow lights corresponding to Open, Closed, and Intermediate positions shall be included on the actuator. The digital display shall be maintained even when the power to the actuator is isolated.

F. The local display should be large enough to be viewed from a distance of six feet (6') when the actuator is powered up.

G. Provide a diagnostic module, which will store and enable download of historical actuator data to permit analysis of changes in actuator or valve performance. A software tool for a PDA or laptop shall be provided to allow configuration and diagnostic information to be reviewed, analyzed and reconfigured.

H. Diagnostic status screens must be provided to show multiple functions. Emergency Shut Down shall be selectable; Last-position, Full Open, Full Closed.

2.7 LOCAL ACTUATOR CONTROL

A. Capabilities shall be provided to position the valve (or gate) locally via the Local/Off/Remote selector switch and Open/Stop/Close push buttons.

B. For on/off service, when in remote, the actuator shall accept one remote signal to open the valve or gate and a second remote signal to close the valve or gate.

C. For modulating service, when in remote the actuator shall accept a 4- 20mADC position control signal, and shall position the valve 0-90 degrees or gate 0-100% of travel in proportion to the control signal.

D. Valve position shall be sensed by an 18-bit, optical, absolute position encoder with redundant position sensing circuits designed for Built-In-Self- Test [BIST]. Each of the position sensing circuits shall be redundant permitting up to 50% fault tolerance before the position is incorrectly reported. The BIST feature shall discern which failures signal a warning only and which require a warning plus safe shutdown of the actuator. Open and closed positions shall be stored in permanent, nonvolatile memory. The encoder shall measure valve position at all times, including both motor and handwheel operation and with or without power present. The absolute encoder will be capable of resolving ±7 degrees of output shaft position over 10,000 output drive rotations.

E. Discrete outputs to SCADA shall be provided for all limit and torque switches, and for Local/Off/Remote switch in Remote position, as required by the Drawings.

2.8 WIRING AND TERMINALS

A. Internal wiring shall be tropical grade insulated stranded cable of appropriate size for the control and three-phase power. Each wire shall be clearly identified at each end. All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.

B. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The terminal compartment of the actuator shall be provided with a minimum of four threaded cable entries.

C. Control logic circuit boards and relay boards must be mounted on plastic mounts to comply with double insulated standards.

D. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:

1. Serial Number

2. External Voltage Values

3. Wiring Diagram Number

4. Terminal Layout

E. This must be suitable for the contractor to inscribe cable core identification beside terminal numbers.

2.9 ACTUATOR CRITERIA

A. Schedule:

Actuator Identification	Filter Equipment Control Valve	Sludge Transfer Valve
Service Condition	On-Off Service	On-Off Service
Electric Service	480 V – 3 Phase – 60 Hz	480 V – 3 Phase – 60 Hz
Actuated Valve Size and Configuration	12-inch Plug Valve	2-inch Plug Valve
Installation Max Differential Pressure	20 psi	20 psi

2.10 WARRANTY

A. Actuator manufacturer shall warrant units supplied against defects in workmanship and materials for a period of not less than one (1) year beginning with the date of final payment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Verify layout and orientation of equipment and accessories. Immediately report discrepancies or conflicts to the Engineer for resolution.

3.2 INSTALLATION

A. Install equipment where indicated on Drawings and in accordance with manufacturer's instructions.

B. Provide and connect piping, power and control conduit and wiring to make system operational, ready for startup.

3.3 FIELD QUALITY CONTROL

A. Section 01700 - Execution Requirements.

B. Start-up and Performance Testing:
   1. Operate equipment under actual field conditions and following installation of all other systems just prior to placement of all Work into operation. Demonstrate all required functionality under supervision of manufacturer's representative and in presence of Owner and Engineer.

C. Equipment Acceptance:
   1. Adjust, repair, modify or replace system components that fail to perform as specified and rerun tests. Make final adjustments to equipment under direction of manufacturer's representative.

3.4 MANUFACTUER’S FIELD SERVICES

A. Section 01400 - Quality Requirements.

B. Furnish services of manufacturer's representative experienced in installation of products furnished under this specification for not less than one eight-hour day on-site for installation inspection and field testing, and instructing Owner's personnel in maintenance of equipment. Make additional trips to site as required for resolution of non-compliant conditions at no additional cost to the Owner.

C. Certify that equipment has been properly installed and is ready for start-up and testing.

3.5 DEMONSTRATION

A. Section 01700 – Execution Requirements

B. Demonstrate equipment startup, shutdown, routine maintenance and adjustments, alarm condition responses, and emergency repair procedures to Owner’s personnel.

END OF SECTION

SECTION 11300

SLUDGE DEWATERING SCREW PRESS

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all labor, materials, tools and equipment required to furnish and install dewatering system as specified herein. The system shall include the screw press unit with filtrate recycle system, polymer blending unit, washwater booster pump and control panel. The screw press system(s) shall be complete and integrated such that it can operate in a fully interlocked manner while achieving the performance requirements as specified in this document.

1.2 RELATED SECTIONS

A. General Conditions, Supplementary Conditions, and General Requirements sections apply to work of this Section.

B. Section 01300 – Submittals

C. Section 03300 – Concrete

D. Section 05500 – Miscellaneous Metals

E. Section 09900 – Special Coatings and Painting

1.3 SUBMITTALS

A. Refer to Section 01330 for shop drawing submittal requirements.

B. The Contractor shall submit complete shop drawings of all equipment furnished including cut sheets describing purchased sub-components with the specific sub-components used for this project properly highlighted. All submitted information must include a certification that the submittal describes exactly the equipment to be provided and substitutions subsequent to submittal approvals will not be tolerated.

C. Complete details of the design, construction, and operating characteristics of the sludge dewatering screw presses and polymer feed systems shall be submitted for review by the Engineer. Submittal data shall include design calculations, descriptions of materials of construction, headloss calculations, anticipated process performance, and all other information necessary to completely describe the system installation.

D. Review of the shop drawings shall not relieve the Contractor from the responsibility of proper fitting and construction of the work, nor from furnishing materials and work required by the Contract that may not be indicated on any drawings.

1.4 REFERENCE STANDARDS

A. American Institute of Steel Construction (AISC).

B. American Iron and Steel Institute (AISI).

C. American National Standards Institute (ANSI).

D. American Society of Civil Engineers (ASCE)

E. American Society for Testing Materials (ASTM).

F. American Welding Society (AWS).

G. Steel Structures Painting Council (SSPC).

1.5 QUALITY ASSURANCE

A. Qualifications: Qualified Manufacturers shall have a minimum of 20 years' experience manufacturing screw presses, with no fewer than 10 operating installations of the type specified herein located in the USA. The manufacturer shall provide a list of 5 names and dates of installations for verification by the Engineer or Owner's Representative.

B. A single manufacturer shall provide all components including but not limited to the screw press, air compressor, booster pump, in-line venturi mixer, process piping, valves, hardware, controls, and control panels as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.

C. Screw press system shall be Manufacturer's standard product and only modified as necessary to comply with the drawings, specifications, and specified service conditions.

D. All welding is performed in accordance with American Welding Society (AWS) Structural Welding Code.

E. All stainless-steel components shall undergo a passivation process to ensure maximum resistance to corrosion. All stainless-steel surfaces shall be thoroughly cleaned and glass bead-blasted to a minimum SSPC-SP-6 finish. The use of nitric and hydrofluoric acid passivation is not acceptable due to the negative impact these chemicals have on the environment.

F. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or installation, defective workmanship or materials, and breakage or other failure. Materials shall be suitable for service conditions.

G. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practices. The fabrication shall be performed by the equipment manufacturer at the manufacturer's facility located within the continental USA; all welding shall be performed by direct employees of the manufacturer, each welder shall be certified in accordance with AWS or ASME. Welder certificates shall be provided to the Engineer upon request.

H. Each screw press system shall have the Manufacturer's name, address, and product identification information on a corrosion resistant nameplate securely affixed to the equipment.

1.6 WARRANTY

A. The manufacturer shall warrant, in writing, that all equipment supplied by them shall be free from defects in material and workmanship, for a period of twenty-four (24) months from the date of acceptance by the owner. The manufacturer shall provide a five (5) year non-prorated warranty covering the frame, frame coating, screw core, baskets, bearings and bearing housings.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Shipping
1. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
2. Pack spare parts in containers bearing labels clearly designating contents and equipment for which they are intended.

B. Receiving and Storage
1. Store and safeguard equipment, material, and spare parts. All spare parts must be stored in accordance with manufacturer's recommendations.

1.8 OPERATION AND MAINTENANCE MANUALS

A. The manufacturer shall furnish operation and maintenance manuals in accordance with the requirements of section 01430 – Operation and Maintenance Manuals.

PART 2 PRODUCTS

2.1 SLUDGE DEWATERING SCREW PRESS

A. Manufacturers
1. BDP Industries – Basis of Design
2. Komline-Sanderson Corporation
3. Charter Machine Company
4. Substitutions: Section 01600 - Product Requirements
5. Basis of Design: Any design modifications required to accommodate equipment by an Approved Manufacturer shall be included in the Contractor's Bid.

B. Operational Requirements:
1. The press shall meet the following operating parameters:

a.	Sludge Feed Solids, % wt	2.5 – 4.5
b.	Solids Throughput, dry lb/hr	600
c.	Sludge Flow Rate, gpm	30 – 50
d.	Maximum Polymer Dosage, lb/dry ton	35
e.	Minimum Discharge Cake Solids, % wt	20
f.	Minimum Solids Capture, %	95

C. General

1. The equipment covered by these specifications is intended to be screw press dewatering equipment of proven ability as manufactured by reputable concerns having long experience in the production of such equipment. The equipment furnished shall be designed and constructed in accordance with the best practice and methods.
2. All components of the sludge dewatering equipment shall be engineered for long continuous and uninterrupted service. Provisions shall be made for easy lubrication, adjustment, or replacement of all parts. Corresponding parts of multiple units shall be interchangeable. Except as otherwise specified, steel plates and shapes shall have a minimum thickness of 1/4" and bolts shall have a minimum diameter of 1/2".
3. All welding shall be in accordance with the latest acceptable codes of the American Welding Society ANSI/AWS D1.6.
4. All material used in the construction of the sludge dewatering equipment shall be of the best quality and entirely suitable in every respect for the service required. All structural steel shall conform to the ASTM standard specification for structural stainless steel, designation A554-MT304. All iron casting shall conform to the ASTM standard specification for gray iron casting, designation A48-76, and shall be of a class suitable for the purpose intended. Other materials shall conform to ASTM specifications where such specifications exist; the use of such material shall be based on continuous and successful use under the similar conditions of service.
5. Unless otherwise specified herein, all metal parts in contact with polyelectrolyte or sludge shall be type 304L stainless steel. All fasteners, pins, and anchor bolts shall be type 304L stainless steel.
6. All fiberglass-reinforced plastics (FRP) shall be manufactured in conformance with NBS standards PS15-69.

D. Surface Protection

1. The main frame and other misc metals, excluding drives, shall be stainless steel per ASTM A554-MT304 specification. Buyouts items will be covered with the following paint system:
    a. First coat of Tnemec #66 epoxy of contrasting color to a minimum of four (4) dry mils thickness.
    b. Apply a second coat of Urethane topcoat, finished color, minimum of four (4) mils thickness. Total thickness of the two (2) coats will be a minimum of eight (8) mils dry.
    c. Hot Dipped or Flame sprayed galvanizing is not acceptable.
2. All pre-painted purchased equipment such as electrical motors, gear boxes, etc., are to be painted with a final coat of the above system.
3. The control panel enclosure shall be NEMA 4X constructed of type 304 stainless steel. Inside of the box will be white.

E. Mechanical Details

1. Main Structural Frame
    a. The frame shall be fabricated from stainless steel structural members designed to adequately support all components and accessories. Steel shall meet the requirements of ASTM A554-MT304; all welding shall be performed in accordance with ANSI/AWS D1.6. Where frame components are bolted, stainless steel fasteners shall be used.

b. The fabricated steel frame shall be designed to withstand the maximum stresses imposed on the individual members with a safety factor of 5. Specifically, the maximum actual stress on any member, connection, plate, etc., shall not exceed 1/5 of the yield strength of the frame material used. The deflection ratio of any structural member shall not exceed L/600 where L is the member span.

c. Drip pans shall be fabricated of a minimum 14-gauge type 304L stainless steel and shall collect filtrate.

d. The framework shall be constructed in such a manner that it will insure absolute plane parallelism of all rotating elements by machined bearing pads.

e. The framework shall be of welded and/or bolted construction. No disassembled component shall weigh more than 5,000 lbs. Lifting lugs shall be provided as necessary to afford convenient access to maintenance points throughout the screw filter.

2. Flocculation/Conditioning System - To achieve rapid contact between sludge particles and a solution of dilute polyelectrolyte, provide:

a. One (1) 316L stainless steel, venturi mixer, shall be provided for each screw press. Each mixer shall be equipped with a Vortex polymer injection ring with four (4) tangentially mounted polymer injectors. The mixer shall be located upstream of the screw press. The screw press manufacturer shall recommend the proper layout of the system. The contractor shall provide spool pieces of the size and number shown on the drawings at alternate locations. Systems that utilize mixing/flocculating tank are not acceptable.

3. Pressure Zone

a. The screw press shall be supplied with a tapered shaft design with a smaller diameter at the inlet and a large diameter at the discharge.

b. Designs that utilize a variable pitch with constant shaft diameter, or designs with two-stage shaft diameters are not allowed.

c. The basket assembly around the screw must be constructed of stainless steel with slotted openings to allow for maximum porosity and avoidance of small diameter holes that tend to plug.

d. Designs that utilize basket assemblies constructed of wedge wire or moving rings will not be allowed.

e. The design of the screw auger shall be a tapered shaft to reduce the volume and therefore provide an increasing pressure profile on the solids. The tapered shaft of the screw is designed to force the sludge closer to the slotted screen, thus reducing the path length for liquid to be expressed from the cake. The tapered shaft reduces the potential of plug formation, where the cake turns with the screw and is not conveyed to the discharge point.

f. The high-pressure section shall consist of a variable pressure cone shaped plate on the discharge opening of the screw press. The cone shall be pneumatically adjustable for automatic operation that avoids binding.

g. Units that do not include a pressure cone will not be considered.

h. The cone shall be actuated pneumatically in both directions.

i. Minimum effective filtration area of the pressure zone of the screw press shall be 90 sq. ft.

4. Shower Wash System

a. A wash station shall wash the screw press section. The wash system shall use high-pressure water spray nozzles. The spray assembly shall be

housed in an enclosure in a manner that contains the spray pattern and mist within the housing assembly. The housing and nozzle assembly shall be readily removable. The housing shall be fabricated from type 304 stainless steel.

b. The screw shower shall be pneumatically actuated with an adjustable timer setting on the OIT.

c. The screw system shower bar shall have nozzles placed to wash both the basket and the inside of the enclosure for simplified operation.

d. Wash water required shall not exceed an average of 2 GPM per unit at 80 psi.

e. The shower system shall include a dual basket strainer.

f. Each shower header shall include a motorized ball valve for remote control of the shower as well as for pre-set timed intervals to wash the equipment.

5. Drives

a. The screw press drive shall be a 3.0 HP variable speed with a variable frequency AC drive unit. Multiple belt drives shall not be acceptable.

b. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Each drive unit shall be designed for 24-hour continuous service.

c. Each gear reducer shall be totally enclosed, water spray proof, oil lubricated with anti-friction bearings throughout. All motors shall be TEFC.

d. The screw auger drive shall be a 3 HP, shaft-mounted motor and gear reducer assembly. The drive must be on the discharged end of the screw shaft to reduce wear on the screen and flights due to deflection of the screw shaft.

e. The drives shall be furnished with provisions for use on 480-volt, 60 hertz, 3-phase power supply.

6. Safety Guards

a. All equipment having exposed moving parts such as fans, V-belts, gears, couplings, chains, and including the pressure roll section, shall be provided with safety guards as required by OSHA standards.

7. Bearings

a. The shafts shall be equipped with heavy-duty greaseable type, self-aligning ball or roller bearings in sealed, splash proof housings. The housing shall be sealed to provide adequate protection from moisture and grime.

b. All bearings shall have a minimum B-10 bearing life of 500,000 hours based on ANSI-B13.6-1972. The B-10 bearing life of 500,000 hours shall be based on the maximum summation of all forces applied to the bearing.

c. Bearings and housings shall be US manufactured and shall be manufactured by FMC Corporation, Link-Belt Division, Indianapolis, Indiana; Reliance Electric Industrial Company, Dodge Division, Greenville, South Carolina or equal.

8. Drainage Pans

a. Drainage pans shall be supplied as necessary to contain all filtrate and wash water within the unit and to reduce rewetting of downstream cake. Filtrate and wash water pans shall be constructed of minimum 14-gauge type 304 stainless steel. All drainage piping shall be furnished adequately sized for the intended service and rigidly attached to the press frame.

2.2 ELECTRICAL REQUIREMENTS

A. General Requirements

1. Refer to Specification Section 16480 ("Manufactured Control Panels") for additional requirements.
2. Provide one control panel constructed of 304 stainless steel, NEMA 4X construction.
3. The panel shall be a full operating panel complete with all motor control and supervisory devices for press-mounted and ancillary equipment. All electrical work shall be performed in accordance with applicable local and national electric codes. The control panel shall include an Allen Bradley Compact Logix 5069 PLC and a 12" color OIT Panel View Plus 7 touch screen. An Ethernet switch with fiber optic ports shall be provided for communication with plant control system, and a fiber optic patch panel shall be provided (within this control panel) as required (Refer to Plant Network Diagram on electrical plans for associated fiber optic cable type). Allen Bradley AC Power Flex 525 Variable Frequency Drives shall be provided within the control panel for each of the following individual components in the local control panels:, Screw Press drive, Filtrate Recycle Pump drive, and Sludge Transfer Pump. NEMA-rated FVNR or FVR starters (as required) shall be provided within the control panel for the Sludge Press Booster Pump and the Sludge Press Discharge Sludge Auger(s).
4. The ancillary equipment to be controlled by this panel includes the sludge feed pump, polymer blending unit, discharge auger system. The discharge auger will have motor starters in the control panel. All motor starters and VFDs will be protected by in-line dedicated circuit breakers. The PLC will include logic for all necessary system interlocks and will control process and emergency shutdowns.
5. The controls shall be such that selection of the desired ancillary equipment is easily accomplished at the OIT touchscreen for the Screw Press.
6. Three phase, 460 volt, 60-Hertz power shall be supplied to the control panels. A control transformer will be provided for 120-volt, single phase power source for motor starter coils, lights, relays, timers, controllers, and other related items.
7. Each control panel shall be provided with terminal blocks for power wiring to and from the panel. The incoming terminal blocks shall be provided with a single magnetic circuit breaker disconnect switch. Circuit breaker protected motor starters with thermal overloads shall be supplied for each motor furnished with the unit.
8. All electrical equipment controls located on each screw press shall have NEMA 4X enclosures and wired, through PVC conduit, to a single common NEMA 4X terminal box.
9. All devices within the panel shall be permanently identified. Nameplates shall be provided on the face of the panel or on the individual device as required. Nameplates shall be made of laminated phenolic materials with a white face and a black core.
10. The panel shall be designed for manual starting and stopping of all drives. A master manual / auto system switch shall be supplied to override the alarm system and allow operation of any drive through a momentary contact pushbutton. The control panel shall contain start/stop pushbuttons, run lights, and alarm indications for all ancillary equipment.
11. The operator interface terminal (OIT) touchscreen shall be equipped with a start/stop switch and run light for each adjustable piece of equipment. The screw drives as hereafter specified, shall also incorporate speed control and speed

indication. The control panel shall include start/ stop pushbutton, run lights, speed control and 4 to 20 mA signal generators for the polymer solution and sludge pumps controls.

12. Alarm lights, sensors, and related circuitry shall be provided for the following functions: zero speed, emergency stop push button on each side of the press, low water pressure, and low air pressure. In the event of any of the above malfunctions, the machine will shut down and an alarm sound. The alarm system shall include an audible horn rated at 90 DBA at 10'. The system shall include silencing provisions, but the function alarm indicating light shall remain lit until the alarm condition is satisfied. A separate set of alarm contacts shall be provided for remote alarm indication.

13. Arrange control panel to allow either manual or automatic control of screw press equipment. When "MANUAL" operation is selected, all equipment associated with the screw press shall be controlled by "START/STOP" pushbuttons. When "AUTOMATIC" operation is selected, control of equipment shall be "AUTOMATIC/START" and "AUTOMATIC/STOP" pushbuttons, and programmable controller:
    a. Local screw press control panel shall include OIT touchscreens with the following:
        1) One control mode selector switch marked "AUTOMATIC/ MANUAL." When "MANUAL" operation is selected, all equipment associated with screw press shall be controlled by "START/STOP" pushbuttons. Provide one "START" and one "STOP" pushbutton for each of the following:
            a) Screw Press Drive.
            b) Filtrate Recycle Pump Drive.
            c) Wash Water Pump.
            d) Sludge Pump
            e) Polymer Pump
            f) Discharge Auger(s).
        2) One speed potentiometer for manual adjustment of each drive speed.
        3) Digital indicators for sludge feed flow rate. Indicators shall accept 4 to 20 mA DC field input and shall be calibrated in gpm.
        4) Green indicating lights for "RUNNING" status for each unit operated from panel, including wash water solenoid valve energized indication.
        5) Red indicating lights for "OFF" status for each unit operated from panel, including wash water solenoid valve de-energized indication.
        6) One each "AUTOMATIC/START" and one "AUTOMATIC/STOP" momentary pushbuttons, for automatically starting and stopping each screw press system. Sludge cake auger shall be manually controlled when screw press control mode selector switch is in either the "AUTOMATIC" or "MANUAL" position.
        7) One "Emergency Stop" red mushroom pushbutton.

14. Automatic Controls and Sequencing:
    a. General:
        1) Program the PLC for automatic control of screw press, system sequencing, and interlock functions as specified.

2) Configuration and programming of PLC system shall be the responsibility of screw press manufacturer. System documentation including memory loading, I/O configuration and programming shall be provided.

3) Provide and install auxiliary relays and wiring for equipment and devices specified in this Section required for implementing functional requirements specified.

b. "AUTOMATIC Start/AutoMATIC Stop" Cycle (typical for all screw presses):

1) Automatic start cycle request to PLC shall be initiated by "AutoMATIC/START" pushbutton.

2) Control logic for an "AutoMATIC/START" cycle shall start screw press in the following order after "AutoMATIC/START" command has been initiated and interlocks are complete.

a) Wash water motorized ball valve.
b) Wash water pump.
c) Screw Shower "Pre-Wash"
d) Discharge augers.
e) Screw press drive.
f) Polymer solution pump drive.
g) Sludge feed pump drive.

3) Control/monitoring/power provisions/interlocks for the following equipment shall also be provided from this panel:

a) Sludge Transfer Plug Valve Actuator
b) Sludge Transfer Pump Flow Transmitter
c) Sludge Polymer system Mixer Actuator & Pressure Switches

4) Each drive shall not start until previous drive is running and necessary time delay has elapsed. The screw press manufacturer shall determine where time delays are required and shall program settings to provide smooth start-up of equipment.

5) Once all drives are confirmed running by motor run contacts from their respective starters, PLC shall cause the run indicating light to illuminate. Loss of run status contact for a drive once cycle logic is complete shall shut down screw press and associated equipment.

6) Upon "AutoMATIC /STOP" command, system shall shut down in order that is reverse of specified start-up order with necessary time delays.

c. Interlocks: The following interlocks shall be satisfied when control mode selector switch is in either "Automatic" or "Manual" position. Failure of any one signal during start cycle or after cycle is complete shall shut down all associated screw press equipment.

1) Sludge cake augers servicing the screw press shall be operating and confirmed by auger zero speed switches.

2) Wash water pump must be on and sufficient washwater pressure must be sensed at a specified level.

3) Air pressure must be sensed at a specified level.

4) Polymer activation tank level must be at specified level.

5) Control mode selector switch shall be in "AutoMATIC" position.

6) "Emergency Stop" pushbuttons (local and remote) shall be in operating position.

15. Annunciation and Alarms:
    a. Provide audible alarm and detailed alarm history in screw press control panel for alarming of the following:
        1) Screw drive failure.
        2) Local emergency stop initiated at either screw press control panel, screw press frame-mounted buttons or auger pull cord switches.
        3) High discharge pressure at sludge feed pump.
        4) Low washwater pressure.
        5) Low air pressure.
        6) Discharge augers zero speed switches.
        7) Polymer pump failure.
        8) Sludge pump failure.
        9) Polymer activation tank low level alarm.
    b. Wire all alarms to PLC system for relaying to remote location.
16. Additional stations shall be included as hereinafter specified for other ancillary drives or systems.

B. Electric Motors furnished with this equipment shall meet the following requirements:
1. Rated for continuous duty at 40oC ambient and insulated with a minimum of Class F insulation, with Class B temperature rise. All motors shall be totally enclosed, fan cooled or non-ventilated. All motors supplied shall be rated at 150% nameplate horsepower of the required horsepower maximum service condition.

2.3 AIR COMPRESSOR

A. A complete pneumatic system shall be provided and shall include an air compressor and air drier. This package shall include pump, motor, valves, air tank, all controls and piping as necessary to provide a complete and operating system. The unit shall include a low-pressure switch, system pressure gauge, and pressure relief.

B. The air compressor shall be an Ingersoll Rand T30 2 stage compressor with a 5 HP TEFC motor.

C. The air drier shall be an Ingersoll Rand D31EC.

D. The air compressor unit will be floor mounted away from the press to eliminate wash down spray.

E. The installation contractor shall supply air tubing from the air compressor unit to the press. The contractor shall include quick disconnects for air hose connections.

2.4 POLYMER FEED SYSTEM

A. General Requirements
1. The press manufacturer shall provide as a part of the total dewatering equipment package, one (1) polymer feed system per press capable of automatically metering, diluting, activating and feeding a liquid polymer with water.

B. Polymer Make-Down Unit

1. Polymer and water shall be mixed in a chamber designed to create sufficient mixing energy. This design shall include a progressive cavity metering pump, solenoid valve and pressure regulator.
2. The pumps shall have an adjustable speed with a variable frequency drive. The pumps shall be supplied with a 1/2 hp, 120 volt AC motor.
3. A motor driven impeller mixer shall be provided that will mix the polymer and water into solution.

C. Polymer Feed Pump
1. The polymer system shall be equipped with progressive cavity pump each capable of pumping up to 5 GPH.
2. The pump shall be designed with a high viscosity wet end pump capable of pumping neat polymer solution to the mixing chamber.
3. The pump shall be a Seepex, or approved equal.
4. The drive motor shall be a variable speed, 1/2 horsepower, complete with an SCR control unit. The SCR control unit shall have local speed adjustment, ON-OFF switch and running indication. The control unit shall provide adjustments of feed rate over a range of 20 to 1.

D. Dilution Capability
1. The primary dilution shall feed into the motorized mixing chamber and shall be capable of 1200 GPH.
2. The dilution capability shall be adjustable with a clear rotameter with a stainless steel float.
3. Furnish a solenoid valve or ON-OFF control of dilution water supply

E. Emulsion Unit Control Panel
1. The polymer system shall be supplied with a NEMA 4X control panel that provides an automated mixing system. The controls for the polymer make-down system shall be supplied in the belt press control panel.
2. The control panel shall include all timers and relay for a complete manual and auto system. The polymer mixer chamber and metering pump shall turn on and the water solenoid valve shall open.
3. The polymer feed pump shall include start/stop indicating lights, potentiometer and local remote control.
4. The polymer mixer and polymer metering pump shall be provided with start/stop pushbuttons, indicating lights and motor starters.
5. Single phase, 120 volt, 60 Hertz power shall be supplied to the main control panel.
6. All devices within the panels shall be permanently identified. Nameplates shall be made of laminated phenolic materials with a black face and white core.

2.5 SPARE PARTS

A. Ten (10) spare spray nozzles per press.

B. Two (2) relays of each type and size per press.

C. One (1) full set of screw wipers per press.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify anchors are correctly positioned.

3.2 FIELD PREPARATION AND PAINTING

A. The Contractor shall touch-up all shipping damage to the paint as soon as the equipment arrives on the job site.

B. Prior to the assembly all stainless-steel bolts and nut threads shall be coated with a non-seizing compound by the Contractor.

3.3 INSTALLATION AND TESTING

A. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Contractor shall notify Engineer of any significant deviations.

B. Installation of the equipment shall be in strict accordance with the contract documents and the Manufacturer’s instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractor shall install the anchor bolts in accordance with the Manufacturer’s recommendations.

C. Supplier shall furnish the services of a factory-trained Service Engineer for two (2) trips and three (3) days for start-up, commissioning, and operator training.
   1. The Service Engineer shall test each system, inspect the installation, and make recommendations for any necessary mechanical adjustments by the Contractor.

3.4 OPERATOR TRAINING

A. Provide operator training for Owner's personnel after the system is operational. Training shall take place while manufacturer's representative is at the job site for equipment inspection.

END OF SECTION

SECTION 11310

PROGRESSING CAVITY PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Progressing Cavity Pumps for sludge drying feed operations.

B. Related Sections:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 REFERENCES

A. American Bearing Manufacturers Association:
   1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. American Society of Mechanical Engineers:
   1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Shop Drawings:
   1. Submit detailed dimensions for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.
   2. Include manufacturer’s specified displacement tolerances for vibration at operational speed specified for pumps.

C. Product Data: Submit information concerning materials of construction and fabrication.

D. Manufacturer's Installation Instructions: Submit detailed instructions on installation requirements including storage and handling procedures, anchoring, and layout.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

F. Manufacturer's Field Reports: Certify equipment has been installed in accordance with manufacturer’s instruction.

G. Other Information: Technical manuals, parts list, warranty information, equipment storage recommendations.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

B. Operation and Maintenance Data:
   1. Submit five (5) copies of operation and maintenance data in three-ring hard-backed binder, with cover indicating Owner specified station name.
   2. Submit maintenance instructions for equipment and accessories.
   3. Furnish list of equipment and tools needed to maintain and calibrate equipment.
   4. Include detailed dimensions for materials and equipment, including wiring and control diagrams, performance charts and curves, electrical motor data, installation and anchoring requirements, fasteners, recommended spare parts list, equipment start-up documentation.
   5. Motor performance chart exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. Data to include motor starting and no-load characteristics.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Owner's standard.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum 10,000 heavy duty submersible wastewater pumps installed and operating satisfactorily in the United States.

1.7 PRE-INSTALLATION MEETINGS **(Not Applicable)**

A. Section 01300 - Administrative Requirements.

B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements.

B. Inspect for damage.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces. Store and handle products in accordance with manufacturer's recommendations.

1.9 SEQUENCING

A. Section 01100 - Summary.

B. Sequence work to prevent interference with Owner's operation.

1.10 SCHEDULING

A. Section 01300 - Administrative Requirements.

B. Schedule work to install pumps in wet well prior to connecting piping work.

1.11 COORDINATION

A. Section 01300 - Administrative Requirements.

B. Coordinate installation and start-up with Owner and Engineer.

1.12 MAINTENANCE MATERIALS

A. Furnish one complete rebuild kit for each pump.

B. Furnish special tools required for equipment maintenance.

PART 2 PRODUCTS

2.1 PROGRESSING CAVITY PUMPS

A. Manufacturers:
1. Moyno – Basis of Design
2. Sulzer
3. Seepex
4. Substitutions: Section 01600 - Product Requirements
5. Basis of Design: Any design modifications required to accommodate equipment by an Approved Manufacturer shall be included in the Contractor's Bid.

B. General
1. Stainless steel nameplates giving the name of the manufacturer, the rated capacity, head, speed and any other pertinent data shall be attached to each pump.
2. The manufacturer shall supply all motors. The manufacturer shall factory-mount the motors, pumps, gear reduction units, couplings and guards on a common base plate.
3. The nameplate rating of the motors and drives shall not be exceeded, nor shall the motor design service factor be reduced when its pump is operating at any point on its characteristic curve.
4. These Specifications call attention to certain features, but do not purport to cover all details of construction of the units.
5. Pumps shall be heavy duty, positive displacement, progressing cavity type. The pump body shall be of thick-walled cast iron. Suction housing shall be split for easy access and removal. Suction and discharge connections shall be 125 pound raised faced ANSI cast iron flanged. All wetted internal components shall be alloy steel unless otherwise stated in this specification.

6. The pump rotor shall be manufactured in one piece from an alloy steel conforming to BS970, grade 708M40T/709M40T (ASTM A 322, grade 4140/4145) or equivalent. The rotor surface should be coated with hard chrome plate to a nominal thickness of 0.25mm (.010") at the scroll peaks (major diameter).
    a. The surface should be polished to a minimum of Ra 1.6 um (63uin) to maximize stator wear life.
    b. For applications requiring stainless steel, the rotor should be manufactured in one piece from 316 stainless steel conforming to BS EN 10088, grade X2CrNiMo17-12-2 or equivalent.
    c. If a wear resistant coating is required, the rotor surface should be coated with hard chrome plate and the surface polished to a minimum of Ra 1.6 um (63uin) to maximize stator wear life.
7. The rotor shall rotate relative to a one-piece, medium-high acrylonitrile Buna "N" rubber stator of approximate 70 Durometer hardness (Shore A) securely bonded to its steel tube housing. The stator shall be arranged to prevent the pumped material from contacting the bonding or the tube.
    a. The stator shall be fitted with a thermowell and thermocouple sensor for run-dry protection. A controller shall also be provided and shall be installed by the Contractor in a junction box adjacent to the pump as indicated on electrical plans. The controller shall monitor the stator temperature and activate a shutdown and alarm sequence if the stator temperature reaches the adjustable limit on the controller. The controller shall include a manual local and remote reset function. Input to the controller shall be 115VAC/60 Hz.
8. The rotor shall be joined to the drive shaft by a heavy duty, oil lubricated, pin type universal joint.
    a. A two-piece design of connecting rod is required which allows the rotor and stator to be removed without disturbing/dismantling the pump pin-joint drive connections.
9. The rotor and stator shall be capable of being removed and replaced without disturbing or removing the suction and delivery pipe work pump connections. This should also apply to the removal/replacement of the connecting rod, driveshaft and gland seal.
10. De-ragging and unblocking of the suction chamber area should be easily and quickly achieved with unrestricted 360 degree access by removing the patented split suction.
11. Unless otherwise specified or dictated by duty conditions, the gland seal shall consist of a single internally mounted bi-directional mechanical seal. Metallic parts should be manufactured from 316 stainless steel. Face materials should be Silicon Carbide.
    a. The use of carbon on steel based face materials is not permitted due to relatively poor wear life.
    b. Packed glands are non-preferred and only specified for duties where the use of a mechanical seal is not recommended.

C. MOTORS
1. Each pump's motor shall be a horizontal, totally enclosed fan-cooled, induction motor, constant speed, inverter duty, and manufactured by WEG or approved equal.

D. GEAR REDUCTION UNIT
1. Gear reduction shall be oil-immersed helical or worm gears running on anti-friction bearings.

E. COUPLINGS
1. The pump shaft shall be connected with a close coupled flange mounted gear motor with cross drilled shaft.

F. BASE
1. The motor, drive and pump shall be mounted in-line, on a bent steel base.

G. INSTRUMENTATION AND CONTROLS
1. The VFD & controls for the Sludge Transfer Pump shall be provided within the Sludge Dewatering Screw Press Control Panel. Refer to Specification Section 11300 for additional requirements.

H. SURFACE PREPARATION AND SHOP PRIME PAINTING
1. All surfaces shall be prepared and shop primed as part of the work under this Section. Surface preparation and shop priming shall be as specified in Section 09900.

I. ACCESSORIES
1. All accessories shall be furnished by pump manufacturer unless otherwise noted.
2. Contractor shall furnish all bolts, fasteners and related hardware required for pump installation.
3. Pressure Gauges.
   a. Provide gauges immediately downstream of each pump.
      1) Scale range shall be as directed by pump manufacturer for given service.
   b. Discharge gauges shall be provided as an integral part of isolation ring.
   c. Contractor shall provide an additional pressure gauge tap, valve, and connection on both suction and discharge of each pump for connection of additional pressure gauges in future by Owner (there will be a total of four (4) connection taps, two (2) on suction and two (2) on discharge).
4. Pressure Switches, Pressure Transmitters, and Isolation Rings.
   a. Isolation Rings.
      1) Provide an 8-inch pressure isolation ring to be mounted in between two flanges on both suction and discharge piping of each pump.
      2) Isolation rings shall be provided with a Type 316 stainless steel center section and end plates, Buna-N elastomer gasket, Type 316 stainless steel module seal stinger fitting and pipe fittings and filled with silicone fluid. Isolation rings shall be designed to be mounted in between two flange connections nested inside flange bolt circle (wafer-style).
      3) Capable have two separate instruments (pressure switch and separate pressure transmitter) mounted to same isolation ring.
      4) Manufacturer and Model – Onyx Valve, Model PSW, or equal.
      5) Shall be provided by pump manufacturer.
      6) Instrument Connection Size – 1/2-inch NPT.

b. Pressure Switches.
   1) Shall be dual-point pressure switch, snap action, automatic reset, 120 volt, and shall be adjustable over normal operating range as determined by pump manufacturer.
   2) All pressure switches shall have normally open contacts which close when switch is activated.
   3) For discharge, dual-point pressure switch shall shut pump off if either high discharge pressure occurs or low discharge pressure (low/zero flow) occurs to protect pump from over-pressurization and dry running. High and low setpoints shall be determined by pump manufacturer based on operating conditions described herein.
   4) For suction, dual-point pressure switch shall shut pump off if high suction pressure occurs if pump operating in reverse. Shutoff setpoint shall be 30 psi (or other value as determined by pump manufacturer) to protect gear joint seal in suction housing.
   5) Manufacturer and model – pump manufacturer's standard.
   6) Shall be provided by pump manufacturer.

c. Pressure Transmitter.
   1) Shall be capable of mounting to 1/2-inch NPT connection on isolation ring.

J. Operating Characteristics:

Fluid:	2.5% - 4.5% thickened aerobic sludge
Design Conditions:	60 GPM @ 153' TDH
Electrical Service:	460 V/ 3Ø/ 60Hz
Motor HP:	20 HP
Maximum Operating Speed:	300 RPM

K. Pump Warranty:
   1. Pump manufacturer shall warrant units supplied against defects in workmanship and materials for a period of five (5) years or 10,000 hours under normal use, operation and service. Warranty period to extend from date of start-up.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Verify layout and orientation of pumps, accessories, and piping connections.

3.2 INSTALLATION

A. Install pumps where indicated on Drawings and in accordance with manufacturer's instructions.

B. Provide and connect piping, power and control conduit and wiring to make system operational, ready for startup.

C. Flush piping with clean water.

3.3 FIELD QUALITY CONTROL

A. Pre-operational Check: Before operating system or components, make the following checks:
   1. Check pump and motor alignment.
   2. Check for proper motor rotation.
   3. Check pump and drive units for proper lubrication.

B. Start-up and Performance Testing:
   1. Operate pump on clear water at design point for continuous period of two hours, under supervision of manufacturer's representative and in presence of Engineer.

C. Verify pump performance by performing time/draw down test.

D. Check pump and motor for high bearing temperature and excessive vibration in accordance with the manufacturer’s recommendations. Check for motor overload by taking ampere readings.

E. Equipment Acceptance:
   1. Adjust, repair, modify or replace system components that fail to perform as specified and rerun tests. Make final adjustments to equipment under direction of manufacturer's representative.

3.4 MANUFACTURER'S FIELD SERVICES

A. Furnish services of manufacturer's representative experienced in installation of products furnished under this specification for not less than one eight-hour day on-site for installation inspection and field testing, and instructing Owner's personnel in maintenance of equipment.

B. Certify that equipment has been properly installed and is ready for start-up and testing.

3.5 DEMONSTRATION

A. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner’s personnel.

END OF SECTION

SECTION 11341

MAGNETIC FLOW METER

PART 1 GENERAL

1.1 SUMMARY

A. Description:
   1. The Contractor shall furnish, install, test and place in satisfactory operation, 4-wire magnetic flow meters, signal converters, and all accessories and features as shown on the Plans and specified herein, for a complete and operable system.

B. Related Sections:
   1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures.

B. Shop Drawings:
   1. Submit detailed dimensions for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and all other details.
   2. Descriptive literature, bulletins, and catalog cuts of all equipment components to indicate full compliance with these specifications.
   3. Complete bill of materials for all components.
   4. Complete information concerning materials of construction and fabrication demonstrating compliance with these specifications.
   5. Complete spare parts list.

C. Product Data: Submit information concerning materials of construction and fabrication.

D. Manufacturer's Installation Instructions: Submit detailed instructions on installation and configuration requirements including storage and handling procedures, electrical connection, controls setup, anchoring, and layout.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

F. Other Information: Technical manuals, parts list, warranty information, equipment storage recommendations.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories. Record initial settings and parameters for controls equipment.

C. Operation and Maintenance Data:
   1. Submit operation and maintenance (O&M) manuals for all equipment and accessories supplied. Prepare O&M manuals specifically for this installation and provide all cuts, as-built drawings, equipment lists, spare parts lists and sources, manufacturer's recommended preventative maintenance procedures, troubleshooting recommendations, descriptions, etc, that are required to instruct operation and maintenance personnel unfamiliar with such equipment. Include as-built control and electrical diagrams.
   2. Include all manufacturer's data provided in the initial submittal.
   3. Provide list of equipment and tools required to maintain and calibrate equipment.
   4. Provide manufacturer's certification that all equipment has been installed in accordance with manufacturer's instructions.
   5. Provide fully executed warranty document.
   6. Furnish one (1) hard copy of O&M manual in three-ring binder, and electronic copy in .pdf format. Provide minimum of two (2) laminated electrical and control wiring diagrams based on as-built conditions on maximum 11" x 17 sheets.

D. Special Tools: Provide two (2) sets of any special tools required for proper maintenance of all equipment.

E. Spare Parts: Provide spare parts properly bound and labeled for easy identification without opening packaging and suitably protected for long-term storage.

F. Manufacturer's Field Reports: Following performance testing, certify that equipment has been installed in accordance with manufacturer's instructions, and that all systems have been installed properly and are functioning correctly.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Owner's standard.

B. Maintain one copy of each document on site.

C. Actuator and associated valve shall be provided by the same supplier.

1.6 PRE-INSTALLATION MEETINGS – **NOT REQUIRED**

A. Section 01300 - Administrative Requirements.

B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements.

B. Inspect for damage.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces. Store and handle products in accordance with manufacturer's recommendations.

1.8 SEQUENCING

A. Section 01100 - Summary.

B. Sequence work to prevent interference with Owner's operations.

1.9 SCHEDULING

A. Section 01300 - Administrative Requirements.

B. Schedule work to prevent interference with Owner's operations.

1.10 COORDINATION

A. Section 01300 - Administrative Requirements.

B. Coordinate start-up, performance testing, and demonstration with Owner and Engineer. Provide minimum of one week's notice.

1.11 MAINTENANCE MATERIALS

A. Section 01700 - Execution Requirements.

B. Furnish special tools and equipment required for maintenance, repair, and adjustment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The meter shall be as manufactured by:
1. MJK
2. Hach
3. ABB
4. Substitutions: Section 01600 - Product Requirements.

B. All meters on the project shall be of one manufacturer.

2.2 MAGNETIC FLOW METER

A. Electromagnetic flowmeter shall operate on electromagnetic induction principle and give an output signal directly proportional to the liquid rate of flow.

B. Each meter shall have a stainless steel metering tube and a non-conductive liner suitable for the liquid being metered. End connections shall be steel flanged for sizes 1/2" and greater, ANSI Class 150#, for meter sizes up to 24" and AWWA Class B or D for meters

larger than 24". The housing shall be epoxy coated steel, welded at all joints. Bolted coil enclosures shall not be acceptable.

C. The field coils of the meter shall be supplied with a precisely adjusted bi-polar direct current.

D. There shall be no electronic components on the primary flow head. Coil drive power shall be supplied by a remote signal converter. Output signal from the primary shall be fed through 'DS' proprietary cable supplied with the meter to the signal converter.

E. Electrode material shall be Hastelloy C and compatible with the process fluid.

F. Liner material will be hard rubber suitable for service in applications that include raw waste water, sludge and abrasive matter. Liner material shall be NSF approved for installation in potable water.

G. The instrument shall be manufactured in an ISO 9001 approved facility.

H. The meter shall be provided with 316 stainless steel corrosion resistant grounding rings. Grounding electrodes shall not be acceptable.

I. Meter shall be rated for prolonged submergence, NEMA 6P.

J. Meter calibration shall be performed by a direct volumetric comparison method. A calibration certificate shall accompany each meter. Calibration facility shall be certified to .04% accuracy, and be traceable to national standards.

2.3 SIGNAL CONVERTER/TRANSMITTER

A. The Magnetic Flowmeter Converter shall be remotely mounted and provide precisely controlled and regulated, bipolar DC primary field excitation pulses at a keyed frequency of 1/6, 1/16, or 1/32 of line frequency digitally selectable. It shall convert the primary flowmeter signal into a 4-20 mA DC and pulse output directly proportional to the flow rate.

B. Converter shall be rated for 120 VAC operation

C. The full scale measuring range shall be a direct digital input in gpm and fully adjustable over a range from 1.0 to 40 ft/sec.

D. Each converter shall contain self diagnostics, automatic data integrity checking, and be completely interchangeable with other converters of the same type without need for recalibration. No auxiliary test meter or primary simulator shall be required for commissioning, zeroing, or interchanging of flow meter/converter.

E. Each converter shall contain the following features as standard equipment:
1. Simultaneous analog output (750 ohm load) and a scaled pulse output.
2. Adjustable damping of analog signal from 0.2 to 99 seconds.
3. Low flow cutoff.
4. Forward/reverse flow measurement capabilities
5. Integral rate of flow indicator and (2) 8-digit LCD totalizers
6. Capability of testing analog and frequency outputs.

7. Ten year data retention without the need for auxiliary power.
8. Engineering units for display and programming; flow and total shall be user programmable in any engineering unit of measure.
9. HART
10. All adjustments and changes of above features shall be by direct digital input.
11. Repeatability shall be 0.1% of rate.
12. Two (2) 4-20mA (Hart) Outputs

F. Accuracy of the system (Primary Flow Head and Converter) shall be:
1. Meter sizes 3/8" - 24" +/- 0.4% of actual flow rate (for velocities of 1.3 - 40 ft/sec)
2. Meter sizes 28" - 40" +/- 0.5% of actual flow rate(for velocities of 0.8 - 40 ft/sec)

G. The enclosures shall be rated NEMA 4X.

H. Provide a 50 foot signal cable for meters (FE-SP2A & FE-SP2B) in the sludge pump station. Provide a 15 foot signal cable / coil power cable for all others.

I. The instrument shall be manufactured in an ISO 9001 approved facility.

J. Stainless Steel Tags: Provide stainless steel identification tags on primary flow head and signal converter. Attach tags with stainless steel wire or screws.

K. The signal converter shall be Hach model SC200 or equivalent.

2.4 METER CRITERIA

A. Schedule:

Meter Identification	Filter Equipment Influent Flow	Sludge Transfer Flow
Pipe Size and Material	12-inch Ductile Iron	2-inch Stainless Steel
Meter Flow Range	0 – 2,100 gpm	0 – 100 gpm

2.5 WARRANTY

A. Meter manufacturer shall warrant units supplied against defects in workmanship and materials for a period of not less than one (1) year beginning with the date of final payment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements.

B. Verify layout and orientation of equipment and accessories. Immediately report discrepancies or conflicts to the Engineer for resolution.

3.2 INSTALLATION

A. Devices with displays mounted outside shall be mounted facing north, if possible. Install sun shield/shade over unit such that the sun does not directly shine on the LCD/LED display and the unit itself is not in the sun.

3.3 FIELD QUALITY CONTROL

A. Section 01700 - Execution Requirements.

B. Start-up and Performance Testing:
   1. Operate equipment under actual field conditions and following installation of all other systems just prior to placement of all Work into operation. Demonstrate all required functionality under supervision of manufacturer's representative and in presence of Owner and Engineer.

C. Equipment Acceptance:
   1. Adjust, repair, modify or replace system components that fail to perform as specified and rerun tests. Make final adjustments to equipment under direction of manufacturer's representative.

3.4 MANUFACTUER'S FIELD SERVICES

A. Section 01400 - Quality Requirements.

B. Provide manufacturer's Field Service Technician (certified, factory trained) for a minimum of one 8-hour days on site (minimum two trips). Field Service Technician shall calibrate instruments, check all installed equipment, perform initial start-up, make all tests, adjustments and related items as required to ensure that the flow meters are performing and operating as specified and required, and train operators in daily operational procedures, O & M, trouble shooting, and computer operations.

C. Field Service Technician shall verify installation is in accordance with Drawings, Specifications and as instructed by manufacturer. The technician will schedule site visits at scheduled points of construction completion, coordinated with Contractor, to ensure proper installation of equipment, structures and facilities. Technician will coordinate with other manufacturers Field Service Technicians as required.

D. Field Service Technician will instruct Owner's personnel in operational, maintenance and troubleshooting procedures.

3.5 CERTIFICATION OF INSTALLATION

A. Section 01700 – Execution Requirements

B. Upon completion of the installation, the manufacturer shall furnish a certificate of compliance detailing that the instruments and materials have been installed and calibrated in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 11345

HORIZONTAL ULTRAVIOLET DISINFECTION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. This section addresses the supply, delivery, supervision of installation and commissioning of the horizontal ultraviolet (UV) disinfection system as described herein.

B. Related Sections:
1. Drawings and general provisions of the Contract including General and Supplemental General Conditions, and Technical Specifications.
2. Section 16100 – Electrical

1.2 REFERENCES

A. Environmental Protection Agency (EPA)
1. EPA/625/1-86/021 - Design Manual, Municipal Wastewater Disinfection
2. NWRI - National Water Research Institute
3. ADEM Specifications and Regulations
4. IEEE 519-1992 Institute of Electrical and Electronics Engineers Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

1.3 SUBMITTALS

A. Submit four (4) copies of the following shop drawings.

B. Layout, overall dimensions, required clearances and a general description of the equipment, including the location of electrical equipment, control panels and other auxiliary equipment.

C. Details of attaching equipment, services, auxiliary equipment, accessories, *etc*.

D. Complete data on materials to be used for fabrication for those parts in and out of the effluent.

E. Electrical control schematics, wiring diagrams, panel layout and a general description including a list of materials.

F. Operating characteristics of all electrical and control equipment: operating voltage and amperage tolerances and any ancillary electrical services that are required.

G. List of what components and materials shall be shipped preassembled and a parts list for the other components and materials. Weights and physical dimensions shall be indicated for each part, assembly and/or package to be shipped.

H. Provide Operation and Maintenance data for incorporation in the O & M manuals as specified. Include a complete description of the operation of the UV system together with the general arrangement and detailed drawings of the UV system: wiring diagrams for the power and control

system. A parts catalog with a complete list of replacement parts with section drawings illustrating the connections and identifying numbers.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing ultraviolet disinfection equipment who have been in business for a minimum of five (5) years shall be allowed to bid.

B. Only UV manufacturers who have had their system validated via a bioassay test by a third party shall be allowed to bid.

C. The UV manufacturer shall offer state-of-the-art UV technology. The UV system shall include, but not be limited to, low pressure high intensity lamps, high frequency electronic ballasts capable of variable output, status indication of each lamp, baffles and a level control weir for installation in an existing concrete channel.

D. A statement by the equipment manufacturer listing any deviations or exceptions taken to these specifications. Include specification reference and proposed alternative with reason stated for exception.

1.5 DELIVERY AND STORAGE

A. Ship equipment pre-assembled to the degree that is practicable.

B. Provide storage instructions indicating specific requirements to ensure there is no damage to or deterioration of components.

1.6 COORDINATION

A. The Contractor shall coordinate the equipment delivery schedule and installation with the construction schedule.

1.7 PERFORMANCE GUARANTEE

A. The manufacturer shall guarantee that the proposed UV disinfection system shall produce an effluent that meets or exceeds the requirements of this specification. The effluent quality exiting the UV system must be equal to or better than the specification requirements. The guarantee shall be applicable for a duration of twenty (20) years from the date of startup as long as the wastewater flow and quality remains in the range(s) specified in the design criteria.

PART 2 PRODUCTS

2.1 HORIZONTAL ULTRAVIOLET DISINFECTION SYSTEM

A. Manufacturers:
   a. Glasco – Basis of Design
   b. Enaqua
   c. Xylem
   d. Substitutions: Section 01600 – Product Requirements
   e. Basis of Design: Any design modifications required to accommodate equipment by an Approved Manufacturer shall be included in the Contractor's Bid.

B. The UV manufacturer must be able to provide proof of no less than five (5) unique installation of equipment with a capacity equal to or greater than the capacity of the proposed equipment in the United States within the past ten (10) years.

C. The UV disinfection system shall reduce the concentration of viable microorganisms in the treatment plant effluent by irradiation with UV light at a wavelength of 254 nm. Less than 200 Fecal Coliform colonies per 100 mL, based on a 30-day geometric mean, shall be the target that must consistently be achieved.

D. Equipment supplied with the UV system shall include UV lamp racks, supports for the lamp racks, UV intensity sensors, power distribution centers, spare parts and other equipment as required for the complete installation and operation of the system. The system shall be supplied with baffles and a level control weir for installation in an existing concrete channel.

2.2 BASIC DESIGN CONDITIONS

A. The UV disinfection system shall be used to disinfect wastewater that has undergone secondary treatment.

B. The system shall be designed for the following water quality and flow conditions:

1. Design Peak Flow (MGD)	4.99
2. Design Average Flow (MGD)	3.25
3. Minimum Flow (MGD)	0
4. Minimum UV transmission at 254 nm (%)	65
5. Maximum Total Suspended Solids (mg/L)	10
6. Temperature (^{o}F)	20 - 105
7. Effluent Fecal Coliform colonies per 100 mL, based on 30-day geometric mean	120

C. Modifications required to accommodate an alternate unit shall be submitted to the Engineer for approval and all costs associated with any modifications shall be included within the price Bid.

D. The following system configuration shall represent a general configuration accounting for configuration variations amongst manufacturers. These characteristics reflect the minimum number of lamps to be supplied. If it is the opinion of the manufacturer that a greater number of lamps are required to satisfy the disinfection requirements of this project, then the manufacturer shall base its bid on the higher number of lamps and provide detailed information supporting that offering. Alternative configurations meeting the performance criteria detailed within this specification may be evaluated and allowed by the Engineer following review.

1. Number of channels:	1
2. Number of banks per channel:	2
3. Number of racks per bank:	3
4. Number of lamps per racks:	16
5. Number of lamps per bank:	48
6. Total number of UV lamps:	96
7. Number of UV intensity sensors:	2
8. Number of Power Distribution Centers (PDC's):	1

E. The system shall be capable of uninterrupted operation during the removal of UV lamp racks for routine maintenance or for the replacement of parts.

F. The system shall be capable of delivering an average UV dose of 30 mJ/cm2, after 16,000 hours of lamp operation, at the peak flow rate with 65 % UV transmission of the effluent at 254 nm and adjusting for quartz sleeve fouling.

G. The flow through the system shall be turbulent with a Reynolds number greater than 4,000 at average flow.

2.3 MATERIALS

A. All metal components in contact with the effluent and UV light shall be Type 316 stainless steel. Manufacturers that use aluminum on any part of the UV equipment shall not be considered for this project.

B. All other stainless steel shall be Type 304.

C. All wiring exposed to UV light shall be Teflon coated.

D. All material exposed to UV light shall be stainless steel, quartz, Teflon or other UV resistant material.

E. The equipment shall be designed to comply with NEMA 4X (IP65) ratings.

2.4 UV LAMPS

A. The UV system shall utilize low pressure high intensity amalgam lamps of the pre-heat start design.

B. Each lamp shall produce UV light with at least 90% of its emission between the wavelengths of 230 to 300 nm.

C. The lamp shall be rated for an average UV output of 320 W at 253.7 nm after 100 hour burn in. The average UV output of any proposed lamp cannot exceed 40% of the lamp input power.

D. The lamp shall be rated to produce no ozone.

E. The lamps shall have a four-pin electrical connector at one end only.

F. The lamps shall be warranted for a minimum of 12,000 hours operating time under the conditions specified herein prorated after 9,000 hours. In the event of premature UV lamp failure, the UV system supplier shall offer the following:
   1. Lamp failure before 9,000 hours – send a replacement lamp free of charge
   2. Lamp failure after 9,000 hours – issue a credit proportional to the hours not used.

2.5 QUARTZ SLEEVES

A. The quartz sleeves shall be fabricated of Type 214 clear fused quartz circular tubing containing at least 99.9% silicon dioxide.

B. The sleeve wall thickness shall be at least 1.50 mm (nominal).

C. The quartz sleeve material shall be rated for 92% UV transmission and shall not be subject to solarization over its lifespan.

D. The quartz sleeves shall be fabricated with one end closed so that only the open end requires sealing.

2.6 LAMP END SEALS

A. The open end of the quartz sleeve shall be sealed by means of a Type 316 stainless steel nut which threads onto a coupling and compresses a sleeve O-ring.

B. The sleeve coupling nut shall have a knurled surface to allow a positive hand grip for tightening. The nut shall not require any tools for removal.

C. The quartz sleeve shall be held in place by means of an O-ring and compression washer.

D. The UV lamp rack shall be designed to isolate the individual lamps and to prevent moisture from coming in contact with the electrical connections of other lamps in the event of a seal failure or a quartz sleeve fracture.

2.7 LAMP ARRAY CONFIGURATION

A. The lamp array configuration shall be uniform with all lamps parallel to each other and to the flow.

B. The lamps shall be evenly spaced in the horizontal and vertical directions with equal center line spacing in both directions.

C. Vertical lamp configurations shall not be acceptable.

2.8 UV LAMP RACKS

A. Each UV lamp rack shall consist of sixteen (16) UV lamps mounted on a Type 316 stainless steel frame.

B. The ends of the quartz sleeve shall not extend beyond the frame of the UV lamp rack, so that the frame will help protect the lamp/sleeve assembly from breakage.

C. The UV lamp rack shall be connected to receptacles on the Power Distribution Center (PDC) by means of one multi-conductor cable with modular repairable connector. The cable connector and all of its components shall be field repairable. The connector shall be of a "Snap-On" design having no threads that may bind or be subject to cross threading. The connector shall also allow for visual confirmation that the connection is locked in place. Pins shall be made from a copper alloy with hard silver plating. The connector shall be coated with a corrosion resistant finish and all levers, bolts and screws shall be made of stainless steel. The connector shall meet IP65 (UL574) requirements for direct water spray when mated.

D. At the point of exit from the UV lamp rack, the multi-conductor cable shall pass through a water-resistant strain relief.

E. The UV lamp rack shall incorporate a protective shield to prevent UV light from radiating above the lamp bank during normal operation.

F. The UV lamp rack shall be designed to comply with NEMA 4X (IP65) ratings.

2.9 CHANNEL INSTALLATION

A. The system shall be supplied with baffles for installation of system in an existing concrete channel and utilize existing level control weir.

B. The baffles and level control weir shall be constructed of Type 316 stainless steel.

2.10 UV INTENSITY SENSOR

A. A submersible UV sensor shall continuously sense the UV intensity produced in the bank of UV lamps. The sensor shall measure only the germicidal portion of the light emitted by the UV lamps. The sensor shall be factory calibrated.

B. Intensity of the bank of UV lamps shall be indicated in mW/cm^2.

C. The sensor shall provide a 4-20 mA analog output signal for local indication of the UV intensity in the UV bank. The 4-20mA cabling shall be furnished by the UV system supplier (with the associated lamp cabling).

2.11 LEVEL CONTROL SYSTEM

A. The unit shall be provided with the manufacturer's recommended level control system.

B. The provided level control system shall be integrated into the control panel for the unit.

2.12 POWER DISTRIBUTION CENTER (PDC)

A. A PDC shall be provided to supply power to the lamp racks and contains power distribution, electronic ballasts, control and monitoring equipment. Systems with ballasts inside the UV channel will not be permitted. The PDC is fabricated from Type 304 stainless steel. The PDC shall be designed to comply with NEMA 4X (IP65) ratings.

B. Each PDC shall include its own main breaker. This will allow maintenance personnel to perform any service work per local safety regulations.

C. The PDC shall be equipped with the necessary components to allow each bank of lamps to be controlled in either the Remote (Automatic) or Local (Manual) mode. Each PDC shall have a Control Card and Operator Station used to control and monitor the bank(s) of lamps.

D. The electrical supply to each PDC shall be 277/480VAC, 3 Phase unless indicated otherwise on the Drawings.

2.13 ELECTRONIC BALLASTS

A. Electronic ballasts shall be of the rapid start type. The electronic ballast system will provide a minimum power factor of 98%.

B. The lamp current crest factor shall not exceed 1.45.

C. Each ballast shall drive one low pressure high output amalgam lamp for increased redundancy.

D. The ballast shall be capable of providing variable output to the lamp. The variable output shall be a continuous function and not a step function.

E. Each ballast shall provide a lamp failure alarm signal for each of the lamps they drive.

F. The ballast shall be a modular, plug-in device allowing for easy replacement in the field by operators without the need for special equipment.

2.14 CONTROL AND INSTRUMENTATION

A. The UV Control and Monitoring System integrated into each PDC shall include provisions for local indication of the following system parameters:
   1. Individual lamp status
   2. Communications status
   3. Bank UV intensity (mW/cm^2)
   4. Bank ON/OFF status
   5. Bank elapsed time (h)
   6. Cleaning motor status
   7. Bank lamp current (%)
   8. Time before next cleaning cycle (h)

B. The UV Control and Monitoring System shall provide an alarm mode that allows the operator to view up to 20 of the most recent alarms that are still active or have yet to be acknowledged. The alarms displayed shall be common alarms for each UV lamp rack as well as system alarms. Minor and major alarms are defined below.
   1. Minor Alarms
      a. Individual lamp failure
      b. Cleaning motor overload
      c. Bank UV intensity low alarm
      d. High cabinet temperature alarm

   2. Major Alarms
      a. Bank UV intensity low-low alarm
      b. Adjacent Lamp Failure
      c. Multiple Lamp Failure
      d. Circuit breaker/GFI trip alarm
      e. Effluent low level
      f. Loss of UV intensity signal in Remote mode

C. The control system shall provide elapsed time indication for individual banks with a non-resettable timer and shall be displayed when prompted.

D. Lamp on/off cycling is protected by introducing delays to compensate for brief flow fluctuations and to keep energized banks in service for a defined period of time.

E. For a single bank system in Remote mode and with dose pacing enabled, the Ballast Output Current is adjusted such that the Received Dose follows the Applied Dose. If dose pacing is not enabled, the UV Control and Monitoring system shall vary the Ballast Output Current proportionate to the 4-20 mA flow signal from the existing effluent flow meter.

F. For a two-bank system in Remote mode and with dose pacing enabled, the output of the lead bank is adjusted such that the Received Dose follows the Applied Dose. If the Received Dose cannot attain the Applied Dose then the lag bank is energized and after the warm-up period the Bank Output Current of both banks is adjusted such that the Received Dose follows the Applied Dose. The reverse is also true; if the Received Dose is greater than the Applied Dose then the lag bank is de-energized after a 30-minute delay.

G. In Remote mode the lead bank is always energized. The UV Control and Monitoring system shall energize the lag bank under the following conditions:
   1. If the Received Dose cannot attain the Applied Dose in dose pacing mode.
   2. A major alarm condition is detected in the lead bank.
   3. The operator manually rotates the lead bank.
   4. The lag bank delay off timer is set to 30 minutes to prevent unnecessary on/off cycling based on changing process conditions.

H. A form C (normally open (NO) or closed (NC)) dry contact rated for 5A (NO)/3A (NC) at 125 VAC shall be provided as follows:
   1. Minor common alarm condition
   2. Major common alarm condition
   3. Bank ‘A’ status
   4. Bank ‘B’ status, if configured

I. Refer to Specification Section 16480 (“Manufactured Control Panels”) for additional control panel requirements.

J. Connection/integration to the customer SCADA system shall be through a copper Ethernet IP connection via Ethernet IP protocol. Equipment supplier shall provide network ports and/or all software as required to integrate with the SCADA system. The UV system supplier shall provide a network Register Map to the SCADA system integrator. Refer to Specification Section 16480 for additional requirements.

2.15 AUTOMATIC QUARTZ CLEANING SYSTEM

A. The UV module shall have an automatic quartz wiping system to allow the protective sleeves to be cleaned on a predetermined basis.

B. Wiping system shall be pneumatically driven and should be constructed of type 304L or 316L stainless steel (piston and wiper blades).

C. The cleaning system shall have a solenoid valve located within the UV module that shall control the cleaning stroke. A quick stroke approach shall be used.

D. Systems incorporating a motorized traveling worm gear shall not be accepted.

E. The system supplier shall provide an air compressor to actuate the automatic cleaning system.

F. Air compressor shall be oil lubricated.

G. Air compressor shall be sized for a minimum flow of 5 cfm @ 40 psi.

H. Control of the air compressor shall be via pressure switch mounted on the air receiver.

I. Air outlet shall be ¼" FNPT.

J. Air compressor shall be v-belt driven.

K. Accessories:
   1. Air Receiver:
      a. Air receiver shall be 15 gallon, cast iron construction.
   2. Motor:
      a. Motor shall be 2 HP, 120/240 VAC, 50/60 HZ, 1 PH, 15/7.5 Amps.
   3. The air compressor discharge piping shall include:
      a. ASME safety valve
      b. Ingersoll Rand ARO Filter/Regulator
      c. Norgen Excelon 74 Desiccant Compressed Air Dryer

2.16 SAFETY EQUIPMENT

A. The UV system manufacturer shall provide one suitable face shield which will block UV light with wavelengths between 200 and 400 nm from low pressure amalgam lamps.

2.17 SPARE PARTS

A. The following spare parts shall be furnished;
   1. Five (5) – Lamps
   2. Five (5) – Quartz Sleeves
   3. Ten (10) – O-rings
   4. Two (2) – Electronic Ballasts

PART 3 EXECUTION

3.1 SYSTEM DESCRIPTION

A. Furnish all equipment, material, labor and appurtenances required for the complete installation and operation of the packaged UV disinfection system, as specified in this section. The system shall utilize low pressure high intensity lamp technology and high frequency electronic ballasts.

3.2 EQUIPMENT INSTALLATION

A. The ultraviolet disinfection system shall be installed in accordance with the manufacturer's drawings, written instructions, and recommendations. The manufacturer shall provide adequate services as required for proper installation.

B. The manufacturer shall issue a certificate to the Engineer indicating that the system has been properly installed after an inspection and testing of the system.

3.3 MANUFACTURER'S REPRESENTATIVE

A. The manufacturer shall provide the services of a qualified field representative to perform field services including commissioning and instruction of the Owner’s personnel in the operation and maintenance of the equipment furnished. This shall include no less than one eight (8) hour work day exclusive of any travel time to the project site.

3.4 FIELD TRAINING

A. The manufacturer shall provide the services of a qualified representative to train operation and maintenance personnel. Training shall be provided for a total of one-person day after commissioning of the system as scheduled by the Owner. Field training shall cover all of the items contained in the operation and maintenance manual.

END OF SECTION

SECTION 13200

TERTIARY CLOTH MEDIA FILTER EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all labor, materials, tools and equipment required to furnish and install one (1) filter provided in 304 stainless steel tankage as shown on the Contract Drawings and as specified herein. The system shall be factory assembled, so far as possible, with all piping and controls. All surfaces shall be factory painted.

1.2 RELATED SECTIONS

A. General Conditions, Supplementary Conditions, and General Requirements sections apply to work of this Section.

B. Section 01300 – Submittals

C. Section 03300 – Concrete

D. Section 05500 – Miscellaneous Metals

E. Section 09900 – Special Coatings and Painting

F. Division 16 – Electrical

1.3 SUBMITTALS

A. Refer to Section 01330 for shop drawing submittal requirements.

B. The Contractor shall submit complete shop drawings of all equipment furnished including cut sheets describing purchased sub-components with the specific sub-components used for this project properly highlighted. All submitted information must include a certification that the submittal describes exactly the equipment to be provided and substitutions subsequent to submittal approvals will not be tolerated.

C. Complete details of the design, construction, and operating characteristics of the filter equipment shall be submitted for review by the Engineer. Submittal data shall include design calculations, descriptions of materials of construction, headloss calculations, anticipated process performance, and all other information necessary to completely describe the filter installation. All calculations must be stamped by a Registered Professional Engineer in the State of Alabama.

D. Submittal drawings shall be returned to Contractor after initial review. If subsequent submittals are judged by the Engineer to not be in compliance with these specifications, the Contractor shall be required to furnish equipment from another manufacturer meeting the specifications.

E. Review of the shop drawings shall not relieve the Contractor from the responsibility of proper fitting and construction of the work, nor from furnishing materials and work required by the Contract that may not be indicated on any drawings.

1.4 REFERENCE STANDARDS

A. American Gear Manufacturer's Association (AGMA)

B. American Institute of Steel Construction (AISC).

C. American Iron and Steel Institute (AISI).

D. American National Standards Institute (ANSI).

E. American Society of Civil Engineers (ASCE)

F. American Society for Testing Materials (ASTM).

G. American Welding Society (AWS).

H. National Electric Code (NEC).

I. National Electrical Manufacturers Association (NEMA).

J. Steel Structures Painting Council (SSPC).

K. Underwriters Laboratory (UL).

1.5 QUALITY ASSURANCE

A. Qualifications: Qualified Manufacturers shall have a minimum of 10 years' experience manufacturing filters, with no fewer than 10 operating installations of the type specified herein located in the USA. The manufacturer shall provide a list of 5 names and dates of installations for verification by the Engineer or Owner's Representative.

B. A single manufacturer shall provide all components including but not limited to the filter tankage, piping, underdrains, media elements, air compressor, hardware, controls, and control panels as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.

C. Media filter shall be Manufacturer's standard product and only modified as necessary to comply with the drawings, specifications, and specified service conditions.

D. All welding is performed in accordance with American Welding Society (AWS) Structural Welding Code.

E. All stainless-steel components shall undergo a passivation process to ensure maximum resistance to corrosion. All stainless-steel surfaces shall be thoroughly cleaned and glass bead-blasted to a minimum SSPC-SP-6 finish. The use of nitric and hydrofluoric acid passivation is not acceptable due to the negative impact these chemicals have on the environment.

F. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or installation, defective workmanship or materials, and breakage or other failure. Materials shall be suitable for service conditions.

G. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practices. The fabrication shall be performed by the equipment manufacturer at the manufacturer's facility located within the continental USA; all welding shall be performed by direct employees of the manufacturer, each welder shall be certified in accordance with AWS or ASME. Welder certificates shall be provided to the Engineer upon request.

H. Each filter shall have the Manufacturer's name, address, and product identification information on a corrosion resistant nameplate securely affixed to the equipment.

1.6 WARRANTY

A. The manufacturer shall warrant, in writing, that all equipment supplied by them shall be free from defects in material and workmanship, for a period of twelve (12) months from the date of startup, not to exceed eighteen (18) months from the date of delivery, unless noted otherwise within the specifications.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Shipping
1. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
2. Pack spare parts in containers bearing labels clearly designating contents and equipment for which they are intended.

B. Receiving and Storage
1. Store and safeguard equipment, material, and spare parts. All spare parts must be stored in accordance with manufacturer's recommendations.

1.8 OPERATION AND MAINTENANCE MANUALS

A. The manufacturer shall furnish operation and maintenance manuals in accordance with the requirements of section 01430 – Operation and Maintenance Manuals.

PART 2 PRODUCTS

2.1 TERTIARY CLOTH MEDIA FILTER EQUIPMENT

A. Manufacturers:
1. Municipal Filtration Company, LLC – Basis of Design
2. Aqua-Aerobic Systems, Inc.
3. NEXOM
4. Substitutions: Section 01600 - Product Requirements.
5. Basis of Design: Any design modifications required to accommodate equipment by an Approved Manufacturer shall be included in the Contractor's Bid.

B. GENERAL DESIGN REQUIREMENTS

1. Each filter shall be delivered as a complete package and include 100% stainless steel tankage, influent flanged connection, influent distribution channel, influent valves with pneumatic fail open operators, common effluent collection channel, effluent flanged connection, backwash discharge piping with flanged connection, backwash control valves with pneumatic fail close operators, control panel, level monitors, and associated wiring and conduits specific to the filter.
2. All internal components of the filter assembly, including the media support framework, cloth fabric, backwash components, or air headers shall be easily removable from the filter tankage for inspection and media replacement WITHOUT discontinuing or diverting flow from the filter. Systems that require flow to be diverted or discontinued for routine or periodic maintenance shall require additional filters or means to store flow during inspection and media replacement.

C. DESIGN CRITERIA

Average Design Flow (MGD):	1.5
Feed TSS (mg/L):	< 25
Average Feed Lead Concentration (ug/L):	< 10
Effluent TSS (mg/L):	< 5
Number of Filter Units	1
Number of Media Elements per Filter	10
Submerged Cloth Surface Aera per Filter Unit (ft^2)	480

D. PERFORMANCE REQUIREMENTS

1. The filter shall use pile type cloth media to provide filtration of wastewater containing incoming solids from a properly operated secondary treatment process incorporating clarification. Systems that utilize fine mesh screens, micro-screening material, continuously rotating disks, or other non-pile type material for filtration of solids shall not be allowed.
2. The filter shall be composed of multiple, easily removable element frames that support the cloth media material.
3. The filter shall provide a minimum submerged filter surface area of 480 ft^2 as provided by ten (10) individual filter elements, each containing two (2) cloth media panels. Each media element shall be mounted vertically and have an integral connection to the equipment tankage.
4. Filtering elements shall be fixed in place and shall not move during filtration, backwash, or normal operation. Filtration systems that utilize rotating disks, spray bars, or vacuum manifolds shall not be allowed.
5. Each filtering element shall be capable of being removed from the filter independently of other online operating filter elements. Removal of filter elements shall not disrupt flow to other online filtering elements or require incoming flow to be diverted or shutoff during the removal process or while elements are removed.
6. Design total backwash water volume required shall not exceed 5% of the design influent flow.
7. Each stainless-steel filter tank shall be designed to withstand with a prudent safety factor all stresses that may occur during fabrication, erection, intermittent, or continuous 24 hour per day operation. The equipment and controls shall be provided by a single supplier as a complete package to ensure coordination and compatibility.

E. FILTER COMPONENTS

1. Tankage, Piping, Underdrains, and Hardware

   a. All filter tankage, channels, underdrains, and internal piping shall be constructed of 100% 304 stainless steel with sufficient structural stiffening for all loads imposed during shipping, handling, and normal operation.

   b. All filter hardware shall be 100% 304 stainless steel.

   c. Each filter tank shall be shop fabricated, assembled, and shipped as a complete unit.

   d. All fabricated steel shall be 100% stainless steel and shall not require additional coatings. Valve bodies and operators shall be factory painted with the valve manufacturer's standard coating.

   e. Each filter shall include an internal, integrated influent distribution channel with orifices to evenly distribute incoming flow to the filter's online cloth media elements.

   f. Each filter shall include individual, isolated underdrain channels for each included filter element. Each underdrain channel shall be integrated into the tank structure, be isolated from other underdrain channels, and contain influent & backwash piping connection(s).

   g. Heavy solids that enter the filter system shall settle to the bottom of the filter influent channel and underdrain and shall be carried away as part of normal backwash operations. Systems that allow heavy solids to accumulate in a hopper bottom or to accumulate on the media itself shall not be allowed. Systems that require a separate sludge removal step or operation shall also not be allowed.

   h. Each filter shall be equipped with an effluent control box, complete with a fixed stainless-steel weir that is an integral part of the tankage for the purpose of regulating the effluent flow and main tank water level.

   i. All filter internal piping, including influent drop pipes and backwash collection manifold, shall include 125 lb flanges for connection to the tankage and equipment valves. All piping integral to the filter shall be factory installed and tested for leakage and proper fit prior to shipment.

   j. All filter external piping connections, including influent, effluent, and backwash connections shall include 125 lb flanges for connection to system piping provided by the installing Contractor.

   k. Piping to and from filter connection points shall be provided and installed by the installing Contractor, conform to applicable divisions of this specification, and be properly designed to handle all flows under the hydraulic conditions stipulated.

2. Media Elements

   a. Each filter shall include a total of ten (10) filter media elements. Each element shall consist of two (2) flat, rectangular cloth media panels supported by a stainless-steel element frame and connecting hardware. Elements shall be installed in the stainless-steel tankage and connected to the integrated underdrain channels via neoprene gasketed connection interface.

   b. Media elements, including integrated cloth panels, shall not move or rotate during normal filtration or backwash procedures.

   c. All fabricated components of the media element frame, including internal support framework, cloth panel retainer screen and clamps, shall be 100% 304 stainless-steel.

d. Each media element shall be equipped with an integral neoprene rubber gasket for sealing against the element inlet.

e. Media elements shall easily slide into place and be supported along all edges by integral stainless steel locking mechanisms.

f. Media element frame shall include appropriate structural stiffening, internal baffling, and be easily removable from the filter tankage for inspection and media replacement without discontinuing or diverting flow from the filter. Element frame shall be held in place with simple clamps which can be loosened by hand. No tools or dewatering of the system shall be required to loosen or remove media elements or frames from the filter tankage.

g. Media element support frames shall include, integral to the internal structure, an air scour drop pipe and air release header for proper backwash function. Air header shall be integrated within the element framework and be easily removed along with the element frame for inspection and cleaning without discontinuing or diverting flow to the remaining online filter elements.

h. All media elements shall be fixed in place and shall not move during filtration, backwash, or normal operation. Filtration systems that utilize rotating disks, spray bars, or vacuum manifolds shall not be allowed.

i. Systems that require flow to be diverted or discontinued for routine maintenance or element inspection shall require additional filters or means to store flow during inspection and media replacement.

3. Filter Tank Cover

a. Each filter shall include removable cover(s) constructed of 304 stainless-steel which shall prevent sunlight from entering the filter's main filter tank containing the filtering elements. Cover shall include sufficient structural stiffening to be self-supporting. Cover shall be notched to allow element vent hoses to protrude as required. Notches shall include appropriate edging material to prevent abrasion of the element vent hoses during normal operation.

4. Access Walkways, Stairs and Handrails

a. Any access stairway(s), walkways, and handrails required shall be provided by the installing Contractor as shown on the plans. All access stairways and walkways shall be self-supporting and shall not rely on filter tankage for support or connection. All stairways and walkways shall meet OSHA requirements.

F. AIR COMPRESSOR AND ACCESSORIES

1. A 7.5 HP air compressor with 80-gallon vertical receiver and accessories shall be supplied and installed by the Contractor. Installation shall include the provision and connection of all required air piping, pipe fittings, conduit, wiring, pressure regulator, pressure relief valve, pressure switch, manual tank drain valve, lubricants, inline air filters and all other items required for a fully functioning compressed air supply for operation of the pneumatic valves and air scour system of the filter system.

a. Manufacturer

1) Gardner-Denver
2) Quincy
3) Ingersoll-Rand
4) Champion

5) Approved Equal

2. The compressor unit shall be a self-contained, simplex type unit consisting of a single-stage, air-cooled, oil lubricated reciprocating type compressor and motor with V-belt drives mounted on a 80-gallon vertical receiver. Compressor shall deliver not less than 20 cubic feet of free air per minute at inlet conditions compressed to 100 psig. Valves shall be of stainless steel and shall be easily removed or inspected without use of special tools.
3. The compressor receiver tank shall include an automated drain/vent valve to allow condensate to be flushed from the receiver periodically. Condensate shall be routed to an exterior location or interior drain as appropriate for local codes.
4. The motor for the compressor shall be a 7.5 horsepower electric motor operating at no greater than 1800 full-load rpm. Motor enclosure shall be ODP. Motor shall be rated for operation on 480 V, 3 phase power.
5. The compressor shall be furnished with a dry type air filter-silencer.
6. Operation of the compressor shall be automatic start and stop, controlled by an adjustable pressure switch.
7. All rotating parts of the air compressor shall be protected in accordance with the applicable OSHA standards and requirements.
8. Discharge from the compressor shall be regulated to 85-90psi.
9. Inline air filters shall include a minimum 0.1 μm filter along with a coalescing 0.01 μm filter.
10. All air piping and fittings from the receiver tank to the air connection on each filter shall be Schedule 40 red brass or stainless steel in conformance with ASTM B43, ASTM B16.15, ASTM B62, and ASME/ANSI B1.20.1 standards. Pipe size shall be nominal ½-inch diameter, minimum.
11. A 1/2-inch minimum threaded connection shall be provided in the compressed air piping, near the compressor, to allow the connection of an auxiliary air compressor to the compressed air piping system (should the primary air compressor fail). The connection tee shall have two ½-inch brass or stainless-steel ball valves installed to close the auxiliary connection point when it is not in use and to close the primary airline to the installed compressor when the auxiliary connection point is in use.
12. The compressed air system shall include an appropriately sized refrigerated dryer system to condense and remove moisture from the compressor discharge. Dryer shall be powered by 120 V, 1 phase via integrated 3 prong outlet plug. Properly grounded outlet shall be provided by the installing Contractor near the dryer system. Condensate shall be routed to an exterior location or interior drain as appropriate for local codes.
    a. Manufacturer
        1) Gardner Denver
        2) Quincy
        3) Ingersoll-Rand
        4) Approved Equal

G. ELECTRICAL CONTROL PANEL (FCP)
1. Refer to Specification Section 16480 (“Manufactured Control Panels”) for additional control panel requirements.
2. A single electrical filter control panel (FCP) shall be provided to control all necessary functions for operation of the valves and level sensing equipment for all filters.
3. The FCP shall be of NEMA 4X “UL Listed” stainless steel construction.

4. The FCP shall be shipped loose for field mounting near the filters or remotely as shown on electrical plans.
5. An adequately sized hinged front door with 3-point external latching shall be provided on the FCP to contain all the required controls and provide access for repairs & wiring as necessary.
6. The FCP shall use a programmable logic controller (PLC) to provide automatic operation of all filter components and contains the logic components & programmable controls to operate all filter functions.
7. The FCP shall include auxiliary dry contacts for use by the customer (for SCADA monitoring) as shown on electrical plans for General Alarm notification.
8. The FCP shall include an integrated touch-screen operator interface to provide access to control set points, display filter component status & alarms, and provide override control of individual filter components.
9. If the FCP panel is to be mounted outdoors, the FCP shall include an integrated sunshield to cover and protect the operator interface from sun & sunlight exposure.
10. Filter cleaning frequency of each filter shall be regulated by; an adjustable timer integral to the control panel, manual pushbutton override on the operator interface, or by a float switch mounted in the influent channel of each filter to indicate high influent level.
11. The FCP shall be capable of tolerating a power outage for a two-year period without loss of programming or data set points. Battery replacement period shall not be shorter than two years.
12. Contractor shall provide the FCP with a 120-volt, 60 hertz, single phase power supply and include appropriate line surge & ground fault protection as appropriate for local codes. Systems that require 3 phase power, motor starters, motor contactors, transformers, MCCs, or other motor control equipment shall not be allowed.
13. The FCP shall be factory wired and tested and provide clearly identified, industrial type terminal strips for all external field connections.

H. WIRING JUNCTION PANEL
1. Pre-wired electrical junction box(es) shall be provided with each filter to provide connection of all control component wiring, including valve and level sensor wiring, to a remotely mounted filter control panel.
2. Terminals for each component's wiring shall be included. Space shall be provided in the junction box(es) for addition of future wiring for valves and sensors associated with expansion as necessary.
3. Each junction panel shall be of fiberglass construction conforming to NEMA 4X requirements and shall be factory mounted to the filter tankage. A hinged front door shall be provided on the junction panel adequately sized to allow access for repairs and wiring.
4. The junction panel shall be factory wired to valves and level sensors, factory tested, and provide clearly identified, industrial type terminal strips for all external field connections.
5. The installing contractor shall provide wiring, conduit, and wiring connections between the main control panel and the tank junction panel.

I. OPERATION
1. Filtering elements shall be cleaned in sequence, with any filtering elements that are not being cleaned shall be online and producing filtered effluent. Systems that

need to dewater or take more than one filtering element offline at one time shall not be allowed.

2. A programmable controller shall be pre-programmed with the interlocks and sequence logic necessary to control all filter components during all filtering and backwash operations.
3. During automatic operation, the backwash cycle is started by the high-level sensor, manual pushbutton, or pre-set timer through the controller. Once initiated, the influent and backwash valves are operated in sequence allowing each filter panel to be backwashed successively. Backwash cycle times are adjustable through the operator interface panel and can be set in tenths of seconds. The frequency of backwash can also be set through the operator interface and can be set in minutes.
4. Backwash can also be performed by manually operating each valve through use of the override interface which overrides automatic operation.
5. Alarm indicators are included in the interface programming and warn the operator of high-water level, equipment malfunction, and alarm acknowledgment condition.

2.2 SOURCE QUALITY CONTROL

A. All structural steel components shall be fabricated in the United States and shall conform to the requirements of the "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" published by the American Institute of Steel Construction. Except where specifically indicated otherwise, all plates and structural members shall have a minimum thickness of 3/16-inch.

B. The equipment manufacturer's shop welds and welding procedures shall be in accordance with the requirements of the latest edition of ANSI/AWS D1.1 "Structural Welding Code - Steel" published by the American Welding Society.

2.3 SPARE PARTS

A. The following spare parts shall be provided:
   1. One (1) set of filter cloths
   2. One (1) back-up compressor to maintain air supply to filters at all times

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify anchors are correctly positioned.

3.2 FIELD PREPARATION AND PAINTING

A. The Contractor shall touch-up all shipping damage to the surface as soon as the equipment arrives on the job site.

B. Prior to the assembly all stainless-steel bolts and nut threads shall be coated with a non-seizing compound by the Contractor.

3.3 INSTALLATION AND TESTING

A. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Contractor shall notify Engineer of any significant deviations.

B. Installation of the equipment shall be in strict accordance with the contract documents and the Manufacturer's instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractor shall install the anchor bolts in accordance with the Manufacturer's recommendations.

C. Supplier shall furnish the services of a factory-trained Service Engineer for two (2) trips and five (5) days total for start-up, commissioning, and operator training.
   1. Equipment shall not be energized, or "bumped", to check the electrical connection for motor rotation without installation inspection and the Service Engineer present.
   2. The Service Engineer shall test each filter, inspect the installation, and make recommendations for any necessary mechanical adjustments by the Contractor.

3.4 OPERATOR TRAINING

A. Provide operator training for Owner's personnel after the system is operational. Training shall take place while manufacturer's representative is at the job site for equipment inspection.

END OF SECTION

SECTION 13250

PACKAGED GRANULAR MEDIA AND RESIN FILTER SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all labor, materials, tools and equipment required to furnish and install packaged granular media and resin filter system as shown on the Contract Drawings and as specified herein.

1.2 RELATED SECTIONS

A. General Conditions, Supplementary Conditions, and General Requirements sections apply to work of this Section.

B. Section 01300 – Submittals

C. Section 03300 – Concrete

D. Section 05500 – Miscellaneous Metals

E. Section 09900 – Special Coatings and Painting

1.3 SUBMITTALS

A. Refer to Section 01330 for shop drawing submittal requirements.

B. The Contractor shall submit complete shop drawings of all equipment furnished including cut sheets describing purchased sub-components with the specific sub-components used for this project properly highlighted. All submitted information must include a certification that the submittal describes exactly the equipment to be provided and substitutions subsequent to submittal approvals will not be tolerated.

C. Complete details of the design, construction, and operating characteristics of the filter system shall be submitted for review by the Engineer. Submittal data shall include design calculations, descriptions of materials of construction, headloss calculations, anticipated process performance, and all other information necessary to completely describe the system installation.

D. Review of the shop drawings shall not relieve the Contractor from the responsibility of proper fitting and construction of the work, nor from furnishing materials and work required by the Contract that may not be indicated on any drawings.

1.4 REFERENCE STANDARDS

A. American Institute of Steel Construction (AISC).

B. American Iron and Steel Institute (AISI).

C. American National Standards Institute (ANSI).

D. American Society of Civil Engineers (ASCE)

E. American Society for Testing Materials (ASTM).

F. American Welding Society (AWS).

G. Steel Structures Painting Council (SSPC).

1.5 QUALITY ASSURANCE

A. Qualifications: Qualified Manufacturers shall have a minimum of 10 years' experience manufacturing filters, with no fewer than 10 operating installations of the type specified herein located in the USA. The manufacturer shall provide a list of 5 names and dates of installations for verification by the Engineer or Owner's Representative.

B. A single manufacturer shall provide all components including but not limited to the filter vessels, distributor system, filter media, process piping, valves, hardware, controls, and control panels as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.

C. Filter system shall be Manufacturer's standard product and only modified as necessary to comply with the drawings, specifications, and specified service conditions.

D. All welding is performed in accordance with American Welding Society (AWS) Structural Welding Code.

E. All stainless-steel components shall undergo a passivation process to ensure maximum resistance to corrosion. All stainless-steel surfaces shall be thoroughly cleaned and glass bead-blasted to a minimum SSPC-SP-6 finish. The use of nitric and hydrofluoric acid passivation is not acceptable due to the negative impact these chemicals have on the environment.

F. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or installation, defective workmanship or materials, and breakage or other failure. Materials shall be suitable for service conditions.

G. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practices. The fabrication shall be performed by the equipment manufacturer at the manufacturer's facility located within the continental USA; all welding shall be performed by direct employees of the manufacturer, each welder shall be certified in accordance with AWS or ASME. Welder certificates shall be provided to the Engineer upon request.

H. Each filter system shall have the Manufacturer's name, address, and product identification information on a corrosion resistant nameplate securely affixed to the equipment.

1.6 WARRANTY

A. The manufacturer shall warrant, in writing, that all equipment supplied by them shall be free from defects in material and workmanship, for a period of twelve (12) months from the date of startup, not to exceed eighteen (18) months from the date of delivery, unless noted otherwise within the specifications.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Shipping
1. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
2. Pack spare parts in containers bearing labels clearly designating contents and equipment for which they are intended.

B. Receiving and Storage
1. Store and safeguard equipment, material, and spare parts. All spare parts must be stored in accordance with manufacturer's recommendations.

1.8 OPERATION AND MAINTENANCE MANUALS

A. The manufacturer shall furnish operation and maintenance manuals in accordance with the requirements of section 01430 – Operation and Maintenance Manuals.

PART 2 PRODUCTS

2.1 GRANULAR MEDIA AND RESIN FILTER SYSTEM

A. Manufacturers:
1. Tetrasolv – Basis of Design
2. Newterra
3. Champion
4. Substitutions: Section 01600 - Product Requirements.
5. Basis of Design: Any design modifications required to accommodate equipment by an Approved Manufacturer shall be included in the Contractor's Bid.

B. GENERAL DESIGN REQUIREMENTS
1. Packaged system shall incorporate down flow treatment.
2. The package will include all necessary plumbing in order to support parallel, isolation and backwash modes of operation.

C. DESIGN CRITERIA

Vessel Quantity	2
Maximum Flow per Vessel (gpm):	525
Vessel Diameter (inches):	120
Media Capacity per Vessel (ft^3):	280

D. SYSTEM COMPONENTS
1. Filter Vessels

a. Construction
   1) Each filter vessel will be 120 inches in diameter by 96 inches straight seam exclusive of the heads.
   2) Each tank will be welded carbon steel construction conforming to ASME Sec VIII Code.
   3) Each filter vessel will be rated to a design pressure of 75 pounds per square inch at 140 degrees Fahrenheit and tested to 90 pounds per square inch hydrostatic.
   4) Vessel pressure envelope and components directly welded to pressure envelope will be constructed of SA-516 GR70.
   5) All other components welded to vessel will be 5/8" thick SA-36 steel.

b. Nozzles
   1) Each vessel will have:
      a) 8" 150# ANSI RF inlet and outlet
      b) 4" 150# ANSI RF media discharge
      c) 4" 150# ANSI RF media supply
      d) 2" 3000# FNPT vent/utility connection.

c. Manholes
   1) One 24" Round Access located on the lower straight side of each vessel.
   2) One 12" by 16" Elliptical Access located on top of each vessel.

2. Distributor System
   a. Underdrain System
      1) 316 SS Hub and Slotted pipe laterals
      2) Each lateral is 3" deep by 36" long with 0.125" openings.

3. Filter Media
   a. Metsorb HMRG granular media
      1) Clean pressure drop in new condition 4.4 psi
      2) Bed height 42.8 in

4. Process Piping
   a. Gaskets
      1) American Biltrite rubber EPDM NSF full face gaskets supplied by Sur-Seal, Inc. or compatible equal meeting ASTM D2000
   b. Isolation Joints
      1) Neoprene construction with plated steel loose rings.
   c. Manifold Piping
      1) Tees and Elbows
         a) 8" SCH40 Carbon Steel Fittings
      2) Long Pipe Sections and Elbows near top tank flange
         a) 8" SCH40 Carbon Steel
   d. Pressure Relief Piping
      1) 3" SCH40 Carbon Steel
   e. Discharge and Supply Piping
      1) 4" SCH10 304 Stainless Steel Piping
   f. Utility/Vent Piping
      1) 2" Galvanized Sch80 Piping
   g. Instrumentation Tubing
      1) 0.25" Polyethylene

5. Valves
   a. Process Valves

1) 8” Bray Butterfly (Wafer) valves with Gear Handwheel Actuator – Cast Iron Body, Alum/Bronze Disc, Buna-N Seat, SS Stem

b. Media Supply and Removal
   1) 4” Apollo Valve Model SS-3500

c. Utility/Vent Valves
   1) 2” Apollo Valve Model SS-2000

d. Flush Valves
   1) ¾” Apollo Valve Model SS-2000

e. Sample/Instrumentation Isolation Valves
   1) ¼” Apollo Valve Model SS-2000

2.2 INSTRUMENTATION

A. Pressure Indication
   1. Two (2) differential pressure transmitters, 0.5% accuracy, 1/4" fnpt, 4-20ma output, 0-400 inches water differential by ProSense or compatible equal.

2.3 COATINGS

A. Internal Coating
   1. Sandblast SSPC-SP10 – min 4 mil anchor, Plasite 4110, 35 to 45 mils DFT.

B. External Coating
   1. Sandblast SSPC-SP6, Carboline Carboguard 890 to 4-6 mils, Finish Coat Carbothane 134HG to 2-3 mils DFT (Dessert Tan or color by client)

2.4 MISCELLANEOUS

A. Pressure Relief Valves
   1. 3" Globe Style Pressure Relief Valve w/ Position Indicator, Fixed Restriction, Closing Speed Control, 81-RP Pilot, Iso Valves, Class 150, pressure rating 250 psi by Singer or compatible equal

B. Air Release / Air Vacuum Valves
   1. Combination Air Valve, 2” NPT Inlet, DI Body, SST Trim, Epoxy Exterior, 200 psi by Val Matic or compatible equal

C. Media Supply/Discharge Quick Disconnects
   1. 4” Male End – stainless steel Construction

D. Required Utilities
   1. 100 gpm @ 50 psi per 2” wash down nozzle

2.5 SOURCE QUALITY CONTROL

A. All structural steel components shall be fabricated in the United States and shall conform to the requirements of the "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" published by the American Institute of Steel Construction. Except where specifically indicated otherwise, all plates and structural members shall have a minimum thickness of ¼-inch.

B. The equipment manufacturer's shop welds and welding procedures shall be in accordance with the requirements of the latest edition of ANSI/AWS D1.1 "Structural Welding Code - Steel" published by the American Welding Society.

C. The fabrication facility shall successfully meet the quality certification requirements of the AISC Quality Certification Program with a Category I or higher. The AISC Quality Certification Program will confirm that the AISC certified shop has the personnel, organization, experience, procedures, knowledge, equipment, capability and commitment to produce fabricated steel or stainless steel of the required quality for the wastewater treatment equipment.

2.6 SPARE PARTS

A. The following spare parts shall be provided:
   1. Two (2) gaskets for each fitting size and type

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify anchors are correctly positioned.

3.2 FIELD PREPARATION AND PAINTING

A. The Contractor shall touch-up all shipping damage to the paint as soon as the equipment arrives on the job site.

B. Prior to the assembly all stainless-steel bolts and nut threads shall be coated with a non-seizing compound by the Contractor.

3.3 INSTALLATION AND TESTING

A. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Contractor shall notify Engineer of any significant deviations.

B. Installation of the equipment shall be in strict accordance with the contract documents and the Manufacturer’s instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractor shall install the anchor bolts in accordance with the Manufacturer’s recommendations.

C. Supplier shall furnish the services of a factory-trained Service Engineer for two (2) trips and three (3) days for start-up, commissioning, and operator training.
   1. The Service Engineer shall test each system, inspect the installation, and make recommendations for any necessary mechanical adjustments by the Contractor.

3.4 OPERATOR TRAINING

A. Provide operator training for Owner's personnel after the system is operational. Training shall take place while manufacturer's representative is at the job site for equipment inspection.

END OF SECTION

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 DESCRIPTION

A. General Conditions:
1. The accompanying General Conditions (front-end specifications) shall apply to and form a part of this section.

B. General Requirements:
1. Carefully examine General Conditions, other specification sections, and other drawings (in addition to Electrical) in order to be fully acquainted with their effect on electrical work.
2. Do all work in compliance with all applicable codes, laws, and ordinances, the National Electrical Safety Code, the National Electrical Code (hereinafter referred to as "Code"), applicable energy codes, and the regulations of the local utility companies. Obtain and pay for any and all required permits, inspections, certificates of inspections and approval, and the like.
3. Cooperate with other trades and contractors at job. Perform work in such manner and at such times as not to delay work of other trades. Complete all work as soon as the structure and installations of equipment will permit. Patch, in a satisfactory manner and by the proper craft, any work damaged by electrical workmen.
4. The Owner shall be provided access to all software to include copies of software for all systems provided under this division of the specifications. Software shall be password protected where applicable.
5. Only qualified electrical sub-contractors will be allowed to submit proposals for this project. In order to be considered qualified, contractor shall have completed a minimum of five (5) projects of similar type/scope and equal or greater magnitude and complexity within the last ten (10) years. Sub-contractors without qualifications will be rejected. If desired, potential electrical sub-contractors may submit qualification evidence for review and pre-bid approval a minimum of ten (10) days prior to bid. Previous projects used to meet this experience requirement must have included similar (or greater) scopes of work for each of the following areas:
   a. Power Systems.
   b. Control Systems.
   c. Instrumentation Systems.
6. Electrical contracting firm shall be licensed as an electrical contractor in the state where work will be performed

1.2 GENERAL SCOPE OF ELECTRICAL WORK (REFER TO DRAWINGS FOR OTHER SPECIFIC SCOPE ITEMS)

A. Furnish all labor and materials to complete electrical work as shown on drawings and/or herein specified.

B. Remove all existing electrical equipment and wiring made obsolete by this project and remove or relocate all electrical services located on or crossing through the project

property, either above or below grade, which would obstruct the construction of the project or conflict in any manner with the completed project or any code pertaining thereto. Dispose of salvageable materials as directed by the Engineer. Contractor shall schedule meeting to review scope of electrical demolition and to confirm scope and phasing of proposed demolition with the owner in the presence of the prime consultant prior to start of any electrical demolition.

C. Furnish and install complete power, telephone and other electrical services as shown on drawings and/or specified herein.

D. Pay all electrical utility company service charges (if any) in connection therewith, including permanent meter deposit. Meter deposits will be refunded to Contractor at time of Owner's acceptance.

E. Furnish and install complete power distribution system as shown on drawings and/or specified herein.

F. Furnish and install a complete Power Generation and Automatic Transfer Switch System as shown on drawings and/or specified herein.

G. Furnish and install disconnect switches for motors as shown on drawings and/or specified herein.

H. Furnish and install complete electrical grounding systems as shown on drawings and/or specified herein.

I. Install and connect electrical equipment mentioned in Division 16 Specifications or noted in drawings, whether furnished by electrical contractor or by others.
   1. Where shown or specified, equipment furnished by others shall be installed and connected under this Contract.
   2. Where shown or specified, Contractor shall receive, unpack, check and assume custody of equipment furnished by Others. Contractor shall assume responsibility for care and safekeeping of this equipment, when delivered into his custody. He shall protect it from moisture, dust and damage during construction and until Owner acceptance of project.

J. Furnish and install complete electrical lighting systems as shown on drawings and/or specified herein.

K. Furnish and install all electrical items shown on drawings and/or herein specified, unless shown or specified otherwise.

L. Furnish and install complete controls, instrumentation & auxiliary systems as shown on drawings and/or specified herein.

M. Furnish and install a complete Surge Protection System as shown on drawings and/or specified herein.

N. Procure and pay for permits and certificates as required by local and state ordinances and fire underwriter's certificate of inspection.

O. Balance loads as equally as practicable on services, distribution feeders, circuits and buses. Provide typewritten directory for each panel.

P. Unless specifically indicated or required otherwise, terminate all circuitry/cabling provided within this contract at associated equipment/devices/etc. in accordance with all applicable codes, standards and supplier requirements, whether associated equipment/device/etc. is furnished within this contract or by others.

Q. Complete field testing, adjustment & startup of all systems listed above as shown on drawings and/or specified herein.

PART 2 PRODUCTS

2.1 APPROVED MATERIALS AND DEVICES

A. Where not otherwise specified, provide only new, standard, first-grade materials/systems throughout, conforming to standards established by Underwriter's Laboratories, Inc., and so marked or labeled, together with manufacturer's brand or trademark. All equipment/systems subject to approval of Engineer before installation. All like items and associated equipment/systems shall be of one manufacturer.

B. To ensure proper coordination, it is intended that all electrical equipment and materials specified in Division 16 of these specifications and shown on the electrical drawings be furnished and installed by the electrical sub-contractor. It will not be permissible for any of these items to be furnished directly by the general contractor without the electrical contractor's coordination.

C. To ensure commonality of spare parts, it is required that the electrical contractor provide the same brand for all circuit breakers, starters, power equipment, etc. provided under the following divisions of these specifications:
1. SECTION 16055: Power Distribution System Electrical Studies
2. SECTION 16410: Safety Switches And Fuses
3. SECTION 16440: Switchboards
4. SECTION 16442: Lighting Panelboards

2.2 SUBMITTALS

A. All submittals to the design team shall be accompanied by a letter summarizing all proposed deviations from specified products or pre-approved substitutions. The absence of such a letter shall be understood to indicate that the contractor intends to meet all contract requirements, regardless of cut-sheets/data-sheets provided within the submittal.

B. Submit to Engineer ten (10) days prior to bid date three (3) copies of any items and/or manufacturers which are proposed as substitutes for those specified.

C. Submit to Engineer promptly after award of Contract and prior to purchasing, the number of copies required by the contract. All drawings of a specific item or system shall be made in one submittal, and within thirty (30) days after award of Contract. Shop drawings of all power equipment shall contain exact details of device placement, phasing and numbering, in form of elevations, for each major piece of equipment. Shop drawings shall be submitted on the following:

1. SECTION 16055: Power Distribution System Electrical Studies
2. SECTION 16231: Generator Sets
3. SECTION 16289: Surge Protective Devices
4. SECTION 16410: Safety Switches And Fuses
5. SECTION 16415: Automatic Transfer Switches
6. SECTION 16440: Switchboards
7. SECTION 16442: Lighting Panelboards
8. SECTION 16480: Manufactured Control Panels
9. SECTION 16511: Lighting Materials And Methods
10. SECTION 16715: Structured Cabling System
11. SECTION 16850: Electrical Heat Tracing Systems
12. ALL POWER DISTRIBUTION EQUIPMENT (i.e. SWITCHBOARDS, PANELBOARDS, DRY TYPE TRANSFORMER, ETC.)
13. ALL ELECTRICAL AND TELECOMMUNICATION EQUIPMENT LAYOUTS - Submittals shall include ¼" = 1'-0" CAD drawings (hand drawn sketches will not be accepted) of each electrical room, IT room, electrical equipment stand, generator area, or any other similar area with electrical equipment. Drawings shall indicate all panelboards, transformers, switchboards, generators, equipment racks, control panels, HVAC equipment, etc. that are located in each electrical/IT area. Layouts shall show that each piece of electrical equipment has the clearances, working space and dedicated equipment space required by applicable codes. No conduits to equipment within these areas shall be installed until submittals have been provided and returned without exception by the design team.
14. ALL CONTROL ITEMS & SYSTEMS

D. The contractor shall fully review, comment upon and correct all shop drawings as required to assure compliance with contract documents prior to submittal to Engineer. The failure of the contractor to properly review and correct shop drawings prior to submittal will result in rejection of shop drawings by the engineer. Review by the Engineer will be for general conformance with contract documents. The contractor shall be fully responsible for correctness of all submitted dimensions, details, quantities and locations.

E. None of the above items shall be installed until shop drawings or catalog data have been reviewed by Engineer without rejection or required resubmittal. Any listed item not submitted, even if specified, shall be considered not acceptable and shall be removed if directed.

F. Any required resubmittal will be reviewed by the Engineer for conformance with previously issued comments only. The contractor shall be responsible for verifying that all items not specifically requiring resubmittal have not been altered from the previously reviewed submittal.

G. Material proposed for substitution shall be of the same quality, perform the same functions, conform to such physical dimensions and appearance as are required by the Engineer. All material proposed for substitution is subject to the approval of the Engineer and his authority for approval is final. No material proposed for substitution will be considered unless all submittal data complies with the drawings and specifications of Section 16 as to time of submission, number of copies of submittal, and detail requirements.

H. Samples of material shall be furnished where required by drawings or Division 16 Specification, or as requested by the Engineer on items proposed as substitutes.

I. Submit to Engineer a certificate of final inspection from local inspection department.

PART 3 EXECUTION

3.1 SITE VISIT

A. The Contractor shall visit the site to determine existing dimensions and conditions affecting electrical work. Failure to do so in no way relieves Contractor of his responsibility under Contract.

3.2 CLEARANCE WITH UTILITIES

A. It shall be the responsibility of this Contractor, prior to bid, to reaffirm with the utility companies involved, that the locations, arrangement (and with power company voltage, phase, and metering required) and connections to utility service are in accordance with their regulations and requirements. If their requirements are at variance with these drawings and specifications, the Contract price shall include any additional cost necessary to meet those requirements without extra cost to Owner after a contract is entered into.

B. On many projects the utility company may levy charges due to locations, size or type service involved. The Contractor shall be responsible for these charges (including permanent meter deposit), unless such charges are not available prior to bid and Contractor so documents as described below. The meter deposit will be refunded to the contractor at time of Owner's acceptance.

C. Should above cost not be available, prior to bid, Contractor must submit a letter signed by a responsible utility company person so stating with his bid and in turn must be submitted by Prime Contractor with his bid to Owner. The cost will then be deleted from the Contract and become responsibility of the Owner.

D. Arrange with utility companies for such services as shown or herein specified and installation of meter where shown. Furnish with shop drawings a signed document from utility companies describing the location and type of services to be furnished and any requirements they may have. This document shall be signed for each utility company by a person responsible for granting such service.

3.3 WORKMANSHIP

A. All work shall be in accordance with the latest editions of NFPA 70 (National Electrical Code), NFPA 101 (Life Safety Code), National Electric Safety Code, International Building Code, applicable NECA standards and the rules and regulations of State and Local Authorities Having Jurisdiction.

B. All work shall be executed in a workmanlike manner and shall present a neat and mechanical appearance upon completion.

C. All equipment, devices, etc. shall be installed in accordance with manufacturer's recommendations.

D. All items shall be installed straight and plumb in a workmanlike manner and care shall be exercised so that like items are mounted the same position, heights and general location.

E. Keep site clean of accumulation of cartons, trash and debris.

3.4 SAFETY

A. The contractor is solely responsible for all job safety. Engineer assumes no responsibility for job safety. Maximum consideration shall be given to job safety and only such methods as will reasonably ensure the safety of all persons shall be employed. The codes and regulations of OSHA shall be given strict compliance as well as such other codes, laws, and regulations as may be applicable.

3.5 CONTRACT DOCUMENTS

A. Contract documents indicate diagrammatically, extent, general character and approximate location of work. Where work is indicated but minor details omitted, furnish and install it complete so as to perform its intended functions. For details and mechanical equipment, follow drawings provided by other disciplines (Architectural, Mechanical, Structural, Civil, etc.) and fit electrical work thereto.

B. Contract documents consist only of the hardcopy documents issued by the Prime Engineer. Electronic documents issued directly by the electrical engineer to the contractor and/or its sub-contractors/vendors are issued for convenience only (electronic documents are not formal contract documents).

C. If the contractor and/or one of its suppliers require a one-time transfer of electronic files of the current electrical construction documents to prepare shop drawings (or for another similar purpose), it shall:
   1. Sign a waiver prepared by the electrical engineer prior to the transmittal of these files.
   2. Agree to pay the electrical engineer a fee of $50.00 per drawing, up to a maximum of $400 per transfer, payable upon receipt of the files.
   3. To the fullest extent permitted by law, indemnify, hold harmless, and defend JRA from all claims, damages, losses and expenses, including attorneys' fees arising out of or resulting from the use of the CAD files.

D. Take finish dimensions at job in preference to scaled dimensions.

E. Except as above noted, make no changes in or deviations from work as shown or specified except on written order of Engineer.

3.6 UNDERGROUND UTILITY/EQUIPMENT COORDINATION

A. Prior to commencement of work, verify exact locations of all existing or proposed underground utilities and/or underground equipment and verify that proposed electrical installation does not conflict with these items. Notify Engineer immediately if any conflict is found.

3.7 EQUIPMENT STORAGE

A. Store all electrical equipment in dry, covered locations as directed by equipment manufacturers. Contractor shall be responsible for replacing or repairing improperly-stored equipment as directed by Engineer.

3.8 EXCAVATION, CUTTING AND PATCHING

A. Perform all cutting and excavating as necessary for installation of electrical systems, unless specifically covered under another section. After Engineer's observation, complete all excavation, filling and backfilling as directed under specifications for preparation of site and earthwork. Foundations for equipment shall be as specified under concrete section. Concrete pads shall be minimum of 6" thick; unless greater thickness required by equipment manufacturer. Obtain specific approval of Engineer before cutting into any structural members.

B. For all such work employ competent workmen, and finish up in neat and workmanlike manner, equal to quality and appearance to adjacent work.

3.9 PENETRATIONS

A. All penetrations in water tight barriers shall be made so that barrier rating is not compromised. Furnish roof flashing for all equipment installed under Division 16 that penetrates through the roof. Appropriate flashing is specified under roofing and sheet metal section. Supply these flashings for installation under roofing and sheet metal section.

B. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly to maintain the fire/smoke rating of the associated membrane.

C. Where penetrations are required through structural elements, verify penetration locations and sizes with structural engineer. In no case shall the structural integrity be compromised without written approval from structural engineer.

3.10 INSTALLATION OF EQUIPMENT - GENERAL

A. Care shall be exercised in exact routing and location of all items so as not to obstruct access to equipment, personnel walkways, or expose it to potential mechanical damage.

B. Items shall be securely anchored and/or fastened. Provide proper support for all equipment, devices, conduits, boxes, panels, etc. as required by code and for a workmanlike installation. Provide guy wiring for wood poles where required to prevent leaning. All construction shall meet the seismic design requirements of the building code. Items (especially transformers, light fixtures, equipment racks, freestanding gear, etc.) installed in seismic zones C, D, E or F shall be supported and braced per applicable codes and standards.

C. All wall, pole or frame-mounted electrical equipment shall be mounted to metal unistrut (or similar) frames of same material as electrical equipment. For example, pole-mounted stainless steel disconnect switches shall be mounted to stainless steel unistrut frames.

D. All electrical equipment, furnished by Contractor or by others shall be covered and protected during construction.

E. All control cabinets, panels, motor control centers and other electrical cabinets and enclosures shall have all trash removed and be vacuumed clean. All foreign paint, etc., shall be removed from exterior and all scratches in finish touched up with same color and material as original. Any rusted areas shall be sanded, primed and repainted.

F. All relays, starters, push-button and other control devices shall be cleaned and if necessary, lubricated with CRC 2-26 to assure free operation.

3.11 MOTORS, STARTERS AND CONTROLS

A. Unless otherwise specified or shown, all motors will be furnished and installed under other sections of this specification.

B. Electrical Contractor shall install all starters and all electrical power wiring and connections to motors and starters.

C. Unless otherwise specified or shown, all control items for motors shall be furnished, installed and wired in conduit by the electrician.

3.12 CIRCUITS AND BRANCH CIRCUITS

A. Outlets shall be connected to branch circuits as indicated on drawings by circuit numbers. No more outlets than are indicated shall be connected to a circuit.

B. Branch circuit homeruns shall be installed as shown on drawings. Multiple homerun conduits shall not be combined by contractor into larger, single homerun conduits unless specific permission is granted by the Engineer.

3.13 LUG/TERMINAL RATINGS

A. All lug/terminal ratings, sizes, locations, types, etc. shall be coordinated with the associated conductor sizes, types, routings, etc. by the contractor.

B. All lugs/terminals/etc. shall be rated for 75 degree C terminations (minimum, unless specified otherwise).

3.14 EQUIPMENT FAULT CURRENT RATINGS

A. All equipment and breakers shall meet the minimum RMS symmetrical interrupting capacity ratings shown on plans for the associated distribution equipment. All interrupting ratings shall be full ratings. Where new devices or breakers are added to existing distribution equipment, the new devices/breakers shall have interrupting ratings matching or exceeding that of the existing distribution equipment.

3.15 OUTLET LOCATION

A. Symbols shown on drawings and mounting heights indicated on drawings and in specifications are approximate only. The exact locations and mounting height must be determined on the job and it shall be the Contractor's responsibility to coordinate with other trades to ensure correct installation.

3.16 IDENTIFICATION

A. Each panel shall have each circuit identified. Panels without branch circuit nameplates shall have typewritten directories.

B. Each individually mounted switch, circuit breaker, starter and/or any other control or protective device shall identify equipment fed and fuse size, if any, by engraved plastic nameplate, white with black letters, screw attached.

C. See Specification Section 16075 for additional requirements.

3.17 GROUNDING

A. All equipment shall be grounded and bonded in accordance with all state/local regulations, The National Electrical Code and as specified herein.

3.18 PAINTING

A. Refer to Painting/Finishing specifications for requirements regarding field painting of exposed conduit. Any scratches, dents or rust spots in conduit electrical enclosures, panels, motor control or any other electrical items shall have the dents removed, and they, along with any rust spots or scratches, sanded and touched up with the same exact color paint as original finish.

3.19 ACCEPTANCE TESTING

A. Upon completion of work, the entire electrical system installed within this project shall be tested and shall be shown to be in perfect working condition, in accordance with the intent of the specifications and drawings. It shall be the responsibility of the Electrical Contractor to have all systems ready for operation and to have an electrician available to operate same in accordance with and under the supervision of the observation representative(s) of the Engineer. The Electrician shall be available to assist in removal of panel fronts, etc., to permit inspection as required.

B. The electrical sub-contractor shall include in bid price start-up assistance and training from a certified representative of the manufacturer for the following systems:
   1. SECTION 16231: Generator Sets
   2. SECTION 16415: Automatic Transfer Switches
   3. SECTION 16715: Structured Cabling System
   4. SECTION 16850: Electrical Heat Tracing Systems

3.20 OPERATION AND MAINTENANCE DATA

A. One set of marked “AS BUILT” drawings, three (3) sets of all equipment catalog and maintenance data and three (3) sets of all final shop drawings, on all equipment requiring same shall be turned over to owner. These items shall be bound in hard back book. Contractor shall explain and demonstrate all systems to Owner’s representative.

3.21 GUARANTY-WARRANTY

A. Furnish a written Guarantee-Warranty, countersigned and guaranteed by General Contractor, stating:
   1. That all work executed under this section will be free from defects of workmanship and materials for a period of one (1) year from date of final acceptance of this work.

2. Above parties further agree that they will, at their own expense, repair and replace all such defective work, and all other work damaged thereby, which becomes defective during the term of the Guaranty-Warranty.

END OF SECTION 16050

SECTION 16055

POWER DISTRIBUTION SYSTEM ELECTRICAL STUDIES

PART 1 GENERAL

1.1 SCOPE OF WORK

A. THE WORK UNDER THIS SECTION INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING:
   1. Power Distribution System Electrical Studies.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Short Circuit Studies, Protective Devices Evaluation Studies, Protective Device Coordination Studies and Arc Flash Hazard Studies shall be performed by the same entity, which shall be a Professional Engineer registered in the state where the equipment will be installed. The studies shall be per the requirements set forth in the latest edition of NFPA 70E-Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E, Annex D.

B. The studies shall be submitted to the Engineer prior to shipment of any electrical distribution equipment.

C. The studies shall include **ALL** portions of all electrical systems affected by the project (including any existing systems/equipment) from the utility service to any existing equipment at the facility (including all existing equipment fed from the same service point as any new equipment) and to all new equipment installed under this contract. **Note that this includes panelboard/equipment not shown on contract documents. Contractor shall collect field data as required on all existing equipment, feeders, etc.** All induction motors 50 HP or below and fed from the same bus may be grouped together. All induction motors greater than 50 HP shall be included individually with associated starters and feeder impedance. See individual study sections below for additional scope requirements.

D. The studies shall be performed using the latest revision of the SKM Systems Analysis Power*Tools for Windows (PTW) or EasyPower software program.

E. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

F. The contractor shall be responsible for collecting data on any existing or proposed electrical equipment, devices, conductors, etc. as required to prepare the study, and shall supply pertinent electrical system conductor, circuit breaker, generator, and other component and system information in a timely manner to allow the studies to be completed prior to shipment of equipment.

G. The Power Distribution System Electrical Studies shall be performed by Square 'D' or Cutler Hammer; or a third-party vendor if specifically approved by the engineer prior to preparation of the studies.

H. The proposed vendor shall have completed a minimum of five (5) equivalent Arc-Flash Hazard Studies in the past three (3) years.

2.2 SHORT CIRCUIT STUDY

A. The Short Circuit Study shall be performed with aid of a computer program. The study input data shall include the power company's short circuit contribution, resistance and reactive components of the branch impedances, X/R ratios, base quantities selected, and other source impedances.

B. Short circuit momentary duty values and interrupting duty shall be calculated on each individual basis with the assumption that there is a three-phase bolted short circuit at the respective switchgear bus, switchboard, low voltage motor control center, distribution panelboard, and other significant locations throughout the system.

C. The short circuit tabulation shall include symmetrical and asymmetrical fault currents, and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contributions from each connected branch, including motor back EMF current contributions shall be listed with its respective X/R ratio.

2.3 PROTECTIVE DEVICE EVALUATION STUDY

A. The Protective Device Evaluation Study shall be performed to determine the adequacy of circuit breakers, switches, transfer switches, and fuses by tabulating and comparing the short circuit rating of these devices with the calculated fault currents. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied.

B. Any problem areas or inadequacies in the equipment due to short circuit currents shall be promptly brought to the Engineer's attention.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

A. The Protective Device Coordination Study shall be performed to provide the necessary calculation and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage breaker trip characteristics and settings. The objective of the study is to obtain optimum protective and coordination performance from these devices.

B. The coordination study shall show the best coordination attainable for all breakers down through the largest breaker at each piece of distribution equipment. Coordination study shall demonstrate selective coordination where required by applicable codes or contract documents.

C. Phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices. Where ground fault protection is used, coordination of the

ground fault protection with the first downstream overcurrent phase protection device shall be demonstrated.

D. All restrictions of the National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristic curves be maintained.

2.5 ARC-FLASH HAZARD STUDY

A. The Arc-Flash Hazard Study shall be performed with the aid of computer software intended for this purpose in order to calculate Arc-Flash Incident Energy (AFIE) levels and flash protection boundary distances.

B. The Arc-Flash Hazard Study shall be performed in conjunction with a short-circuit Study and a time-current coordination Study.

C. The Arc-Flash Hazard Study shall be performed for the following equipment:
   1. All Distribution Equipment – This includes but is not limited to the following:
      a. Switchgear
      b. Switchboards
      c. Motor Control Center
      d. All Lighting and Power Panelboards
      e. Fused Disconnect Switches rated greater than 100A
   2. Separately enclosed devices fed from protection device rated greater than100A - This includes but is not limited to the following:
      a. Control Panels
      b. VFD's
      c. RVSS

D. A generic Arc-Flash label shall be applied to other electrical equipment that has not been included in the study. This includes but is not limited to the following equipment:
   1. Non-fused Disconnect Switches
   2. Fused Disconnect Switches rated 100A or less
   3. Transformers
   4. Control Panels, VFD's, RVSS, etc. rated 100A or less

E. Where a main protective device is provided, the study shall be performed on the line side and load side of the main. The worst-case result shall be used for the study result and label.

F. The Study shall be performed under worst-case Arc-Flash conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

G. Where incident energies are calculated to fall within the high marginal region of a given Hazard/Risk Category Level, the Hazard/Risk Category Level shall be increased one level.

H. The Arc-Flash Hazard Study shall be performed in compliance with the latest IEEE Standard 1584, the IEEE Guide for Performing Arc-Flash Calculations. Where IEEE 1584 does not have a method for performing the required arc-flash calculations (such as for single phase equipment), calculations shall be performed and system shall be modeled using modules/methods as recommended by the arc flash software supplier (for example,

using SKM Unbalanced/Single Phase Studies module for modeling single phase systems).

I. Equipment labels to identify AFIE and appropriate Hazard/Risk Category in compliance with NFPA 70E and ANSI Z535.4 (latest version of these requirements) shall be provided to the Electrical Contractor. The Electrical Contractor shall affix the labels to the distribution equipment devices as directed by the equipment manufacturer. These labels shall, at a minimum, include the following:
   1. WARNING label.
   2. Hazard/Risk Category.
   3. Arc Flash Boundary Distance.
   4. Incident Energy (in cal/cm2) at Working Distance.
   5. Shock Hazard Voltage.
   6. Limited Approach Boundary Distance.
   7. Restricted Approach Boundary Distance.
   8. Prohibited Approach Boundary Distance.
   9. Equipment Name.
   10. Name of Firm who prepared the Study.
   11. Project Number of the Firm who prepared the Study.
   12. Date that the Study was prepared.
   13. Method for calculating analysis data.
   14. Statement to read: "Any system modification, adjustment of protective device settings, or failure to properly maintain equipment will invalidate this label" (or equivalent).

PART 3 EXECUTION

3.1 SUBMITTAL REQUIREMENTS

A. The results of the studies shall be summarized in a final report. The report shall include the following sections:
   1. General:
      a. Description, purpose, basis and scope of the studies
      b. Single line diagram of the portion of the power system which is included within the scope of the work. The single line diagram shall fit on one sheet of paper (size as required) unless approved otherwise by engineer. The following information shall be shown on the single line diagram:
         1) Device Name
         2) Branch Fault Currents with directional indicators
         3) General Location (for busses only)
         4) Other basic component information such as cable type, cable length, breaker rating, buss short circuit rating, transformer voltages, transformer size, fuse size, etc..
   2. Short Circuit Study:
      a. Tabulation of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties, and commentary regarding same.
   3. Protective Device Evaluation/Coordination Study:
      a. Protective devices time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

b. Fault current calculations including definitions of terms and a guide for interpretation of computer printout.
c. Documentation from utility company on their letterhead showing their anticipated values of available short circuit currents X/R ratios and protective devices with which the power distribution system will coordinate.
d. Time-current characteristics of the respective protective devices shall be plotted on log-log paper. Plots shall be printed in color with a dedicated color and pattern for each curve for clear identification.
e. Plots shall include complete titles, respective single line diagrams and legends, and associated power company's relay or fuse characteristics, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breakers trip curves and fuses.
f. The coordination plots shall indicate the type of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents.
g. The coordination plots for phase and ground protective devices shall be provided on a system basis.
h. A sufficient number of separate curves shall be used to clearly indicate the coordination achieved.

4. Arc-Flash Hazard Study:
a. Tabulation of device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.
b. Recommendations for reducing AFIE levels and enhancing worker safety.

B. Furnish all labor, materials, calculations, electrical equipment, technical data and incidentals required to provide a complete short circuit study, coordination study and arc flash hazard study of protective devices, busses, etc. from the utility service to any existing equipment at the facility and all new equipment installed under this contract.

C. The study shall comply with the following applicable provisions and recommendations of the latest revisions of the following: ANSI C37.5, IEEE Standard No. 399, and IEEE Standard No. 141.

D. Submit calculations and results of the short circuit, protective device evaluation and coordination and arc flash hazard studies prior to submitting shop drawings for new equipment. Contractor shall verify that all proposed equipment is properly rated per the short circuit and protective device evaluation portions of the study prior to releasing equipment for manufacturing.

E. Submit a copy of a sample typical arc flash label layout (meeting requirements outlined above) that will be used for the project.

F. Submit final electronic copies of all SKM program files/models/input data/etc. used to perform the study to the owner with final close-out documents. These files shall be complete as required to allow future users to recreate the study.

3.2 INSTALLATION

A. Contractor shall adjust all breaker settings as recommended by the coordination study prior to energizing equipment.

B. Contractor shall affix arc flash hazard notification labels (as determined by the results of this study) to each piece of distribution equipment prior to energization of equipment. A generic arc-flash warning label shall be affixed to any electrical equipment not included in the analysis as outlined above.

C. Where short circuit rating of equipment is dependent on setting of upstream overcurrent device, provide and install label for equipment indicating the required settings of the associated device.

END OF SECTION 16055

SECTION 16060

GROUNDING

PART 1 GENERAL

1.1 GENERAL

A. THE WORK UNDER THIS SECTION INCLUDES BUT IS NOT LIMITED TO GROUNDING OF THE FOLLOWING:
   1. Service Equipment.
   2. Transformers.
   3. Non-current carrying conductive surfaces of equipment.
   4. Metal Buildings.
   5. Structures.
   6. Other Equipment.

1.2 GENERAL REQUIREMENTS

A. All equipment, building steel, and main service shall be effectively and permanently grounded with a conductor cross section as required by the National Electrical Code and of capacity sufficient to ensure continued effectiveness of the ground connections for fault current. Ground conductors shall be as short and straight as possible, protected from mechanical injury and, if practicable, without splice or joint.

B. All grounding connections shall be installed in accordance with the National Electrical Code and all local codes and requirements. Such codes shall be considered minimum requirements and the installation of the grounding system shall ensure freedom from dangerous shock voltage exposure and provide a low impedance ground fault path to permit proper operation of overcurrent and ground fault protective devices.

PART 2 PRODUCTS

2.1 CONDUCTORS

A. All grounding conductors shall be insulated with green colored, 600 volt insulation unless noted otherwise.

B. Motors having power supplied by single conductor wire in conduit shall be grounded through the conduit system. Flexible conduit shall be “jumpered” by an appropriate bonding conductor.

C. Supplemental grounding system conductors shall be bare, softdrawn, stranded, single conductor copper wire, and generally sized as follows (unless shown otherwise on plans):
   1. Switchgear, motor control centers, and power transformer #4/0 minimum or as shown on plans.
   2. Power panels, #2/0.
   3. Control panels and consoles, #4.
   4. Process Motors, #1/0.
   5. Building Columns, #4/0.
   6. Light Poles, #2.

7. Telephone Backboard & Cabinet ground busses, #2.

2.2 GROUNDING ELECTRODES

A. Grounding electrodes shall be copper-clad steel rods 3/4 inch in diameter and ten feet long. Where longer electrodes are necessary to reduce the ground resistance, Contractor shall provide sectional rods, connectors, drive heads, etc.

2.3 CONNECTIONS

A. All conductor-to-conductor, conductor-to-ground rod, conductor-to-structure, conductor-to-fence connections of #6 and larger sized conductors and underground ground connections shall be permanent exothermic welded connections (Cadweld or equal) unless otherwise noted on applicable drawings.

B. Connections to equipment shall be by bolted compression type lugs (except for motors). When the conductor is #6 and larger, the lug shall be joined to the conductor by an exothermic weld (Cadweld or equal).

C. Motors to be grounded by the grounding conductors run with the power conductors shall have a split-post grounding stud installed in the connection box.

D. Each cast pull box or junction box shall have a ground lug, connected to largest ground conductor to enter box.

E. Ground connections at conduit terminations shall be made by approved grounding bushings (see Raceways Specification Section for additional requirements).

2.4 MANUFACTURERS

A. Conduit clamps and connectors shall be manufactured by Raco, OZ., or Ercon.

B. Lugs shall be as manufactured by Square “D”, Burndy, or T and B.

C. Exothermic weld connections shall be as manufactured by Cadweld, or approved equal.

D. Ground rods shall be as manufactured by Joslyn or McGraw Edison.

E. Split post grounding shall be as manufactured by Burndy or T and B.

PART 3 EXECUTION

3.1 MAIN SERVICE GROUND

A. The main service grounding electrode system shall consist of the following items bonded together by the grounding electrode conductor:
1. The main underground cold water pipe (metal).
2. The metal frame of the building.
3. Driven ground rods. Ground rods shall be embedded at the lowest point in the building and below the permanent moisture level. Ground rods shall be spaced a minimum of ten (10) feet apart and connected in parallel until resistance to ground does not exceed five (5) ohms.

B. The grounding electrode system shall be connected to the grounded conductor (neutral) on the supply side of the service disconnecting means by a grounding electrode conductor not smaller than that shown in Table 250.66 of the N.E.C. The main service equipment grounding conductor shall be connected to the grounding conductor on the supply side of the service disconnecting means in accordance with Table 250.122 of the N.E.C. for the ampere rating of the service entrance equipment. Where in a service entrance switchboard, the equipment grounding conductor shall not be less than 25% of the main bus rating. These connections shall be made inside the service entrance equipment enclosure.

3.2 TRANSFORMER GROUNDS

A. Dry type insulation transformers with a grounded conductor in the secondary shall be grounded in accordance with N.E.C. Section 250-30.

3.3 EXPOSED NON-CURRENT-CARRYING METAL PARTS

A. General: Ground connections to equipment or devices shall be made as close to the current carrying parts as possible, that is, to the main frame rather than supporting structures, bases or shields. Grounding connections shall be made only to dry surfaces that are clean and dry. Steel surfaces shall be ground or filed to remove all scales, rust, grease, and dirt. Copper and galvanized steel shall be cleaned to remove oxide before making welds or connections. Code size ground conductors shall be run in all power conduits and properly terminated at each end.

B. Ground conductors shall be routed as straight as possible. Where possible, ground conductors shall be routed such as to avoid bends exceeding 90 degrees or with a radius of less than 8".

C. Motors: Exposed non-current-carrying metal parts, shall be grounded by a grounding conductor either run with power conductors, and/or separate grounding conductors. Drawings will show method(s) to be used. The ground conductors with all motor conductors shall be connected to the ground buss in the motor connection box. Jumper connections shall be installed between frames and rigid conduit for equipment having flexible conduit connections (sealtight). All AC motor grounds shall provide a low impedance path to ground. Connections from the supplemental grounding system (when specified) shall be made directly to the motor frame. Additionally, utilization equipment connected to the motor (pump, fan, mixer, etc.) shall be bonded to the motor with flexible braid-type bonding strap to ensure equalization of ground potentials.

D. Raceways & boxes: All raceways, conduits, armored or shielded cable and all exposed non-current carrying metal parts shall be grounded. Such items shall be bonded together and permanently grounded to the equipment ground buss. Metallic conduits shall be connected by grounding or clamps to ground buss. Flexible "jumpers" shall be provided around all raceway expansion joints. Bonding straps for steel conduit shall be copper. Jumper connections shall be provided to effectively ground all sections or rigid conduit connected into plastic pipe. No metallic conduit shall be left ungrounded. In conduit systems interrupted by junction or switch boxes where locknuts and bushings are used to secure the conduit in the box, the sections of conduit and box must be bonded together. If conduit, couplings or fittings have a protective coating or non-conductive material, such as enamel, such coating must be thoroughly removed from threads of both couplings and conduit and the surface of conduit or fitting where the ground clamp is secured.

E. Enclosures: Metal conduits entering free standing motor control centers, switchboards or other free standing equipment shall be grounded by bare conductors and approved clamp. Any conduits entering low voltage (480 volts or below) equipment through sheet metal enclosure and effectively grounded to enclosure by double locknut or hub need not be otherwise bonded.

F. Equipment: In addition to equipment grounding provisions mandated by code requirements, additional equipment grounding provisions (including local ground rods, connections, etc.) shall be provided by the contractor as directed by equipment suppliers.

G. Both ends of ground busses in motor control centers, switchboards, etc., shall be separately connected to the main ground buss to form two separate paths to ground.

H. Fences and Grills: Fences and metal grills around equipment carrying voltage above 500 volts between phases shall be bonded together and to ground. Fences and grill work shall be grounded at every post, column, or support, and on each side of every gate.

3.4 ACCEPTANCE DOCUMENTATION AND TESTING

A. Contractor shall take and store photographs of all underground grounding system connections prior to burial of connections, for review by Engineer.

B. Upon completion of work, the entire ground system shall be shown to be in perfect working condition, in accordance with the intent of the Specifications.

C. Contractor shall measure the resistance between the main ground bonding jumper to true earth ground using the Fall of Potential method as described by ANSI/IEEE Standard 81 (“Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of an Earth System”). If the measured value is greater than five ohms, additional grounding electrodes shall be installed as described in Part 3.1 above. The final ground resistance value shall be submitted in writing, and documented via picture of the meter reading from the Fall of Potential test, to the Engineer prior to the final observation, and shall be included in final O&M documentation.

END OF SECTION 16060

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 DESCRIPTION

A. Wire and cable identification.

B. Pullbox & Junction Box Identification

C. Electrical distribution & utilization equipment identification.

D. Instrument and control device identification.

E. Raceway identification.

PART 2 PRODUCTS

2.1 WIRE AND CABLE IDENTIFICATION

A. Intermediate Locations:
1. Wires and cable labels shall be white, thermal transfer, halogen-free, flame-retardant marker plates (sized to accommodate three lines of text) permanently affixed to the associated cable with UV-resistant plastic wire ties. Labels shall be Panduit #M200X/300X series or equal.

B. Circuit/Cable Termination Locations:
1. Wires and cable labels shall be non-ferrous identifying tags or pressure sensitive labels unless noted otherwise.

2.2 ELECTRICAL DISTRIBUTION & UTILIZATION EQUIPMENT IDENTIFICATION

A. Labels on electrical distribution & utilization equipment shall be black-on-white engraved Bakelite nameplates permanently affixed to the equipment with rivets or silicone adhesive unless noted otherwise.

2.3 INSTRUMENT AND CONTROL DEVICE IDENTIFICATION

A. Instruments and control device labels shall be black-on-white engraved Bakelite nameplates permanently affixed to the equipment or the adjacent, visible mounting surface with silicone adhesive or stainless steel wire ties.

2.4 RACEWAY IDENTIFICATION

A. Raceway labels shall be white thermal transfer marker plates permanently affixed to the associated raceway with stainless steel wire ties, with two wire ties (one on either end of marker plate to provide a flush installation) where possible. Labels shall be Panduit #M300X series or equal.

PART 3 EXECUTION

3.1 GENERAL

A. Any proposed deviation in identification methods and materials from those described herein shall be submitted to Engineer for review and comment prior to installation.

B. Contractor shall provide all labeling or identification required by applicable local, state and national codes. These specifications do not intend to itemize all code-required labeling or identification requirements.

C. All labels/identification shall be positioned such as to be readable from the normal perspective without adjusting wiring/cables/labels. For example, labels/identification of wires/cables within cable trays shall be positioned to point towards the viewer (typically downward for overhead cable trays, or upward for cable trays within trenches).

D. All labels/identification (except for handwritten labels on concealed pullbox/junction box covers as noted below) shall be typewritten/printed/engraved in a neat, workmanlike, permanent, legible, consistent and meaningful manner. Labels shall not be handwritten unless specific approval is granted by engineer.

3.2 WIRE AND CABLE IDENTIFICATION

A. General:
1. Where cabling is exposed (such as within cable trays), provide two wire ties per cable (one on either end of marker plate to provide a flush installation). Where cabling is concealed (such as within pullboxes/wireways), one wire tie per cable will be acceptable.

B. Intermediate Locations:
1. Thermal transfer labels shall be securely fastened to all wiring and cabling in the following locations:
   a. Wireways
   b. Pullboxes/Junction boxes larger than 4-11/16”
   c. Pullboxes/Junction boxes through 4-11/16” where wires and cables are not easily identifiable via the color coding and box labeling
   d. Vaults & Manholes
   e. Approximately every 50 feet within cable trays (especially at locations where cables exit or diverge). Labels within cable trays shall be grouped (rather than being pre-labeled on cables and pulled into cable trays).
   f. Other similar intermediate locations.
2. Labels shall be stamped or printed with the following data so that the feeder or cable can be readily identified and traced:
   a. From where the circuit originates (including panel designation and circuit number):
      1) Ex: “FROM: PP-A CIR. 3 (IN MAIN ELEC ROOM)”
   b. To where the circuit extends (using the common name of the equipment):
      1) Ex: “TO: RTU-6 (ON ROOF)”
   c. The purpose of the circuit:
      1) Ex: “POWER”
   d. The set number (If parallel power feeds are used).
      1) Ex: “SET NO. 3 OF 4”

C. Circuit/Cable Termination Locations:
   1. Where multiple termination points exist within a circuit origination point (panelboard, switchboard, MCC, starter, etc.) or other similar circuit endpoint (control panel, etc.), labels shall be securely fastened to all ungrounded and neutral conductors to clearly identify the terminal and/or circuit number associated with each conductor. For example, within lighting panels, each phase and neutral conductor shall be labeled near the terminals at a clearly visible location with the associated circuit number(s), so that if all conductors were unterminated, the labels would clearly indicate which conductor was associated with each circuit.

D. Refer to Specification Section 16120 for all color-coding requirements of wires and cables.

3.3 PULLBOX & JUNCTION BOX IDENTIFICATION

A. Concealed pullboxes/junction boxes:
   1. Front surface of all pullbox/junction box covers in concealed areas (such as above lay-in ceilings) or within mechanical/electrical rooms (and other similar areas where appearance of boxes is not an issue) shall be neatly marked with the ID of circuits/cables contained with permanent black marker on cover of box (Ex: “RP-1A Cir. 1, 2 & 3”). Additionally, front surface of box shall be painted red where box contains fire alarm system cabling.

B. Exposed pullboxes/junction boxes:
   1. Interior surface of all pullbox/junction box covers in exposed areas shall be labeled “Power”, “Telecommunications”, “Fire Alarm” or with other similar general text neatly with permanent black marker to indicate function of box. Circuit/cable labeling within box (see above) shall identify specific cables contained. Additionally, interior surface of cover shall be painted red where box contains fire alarm system cabling.

C. Where pullboxes/junction boxes are named on contract documents (Ex:”PULLBOX #3”), an engraved nameplate shall be installed on the front surface of the box to identify the name.

3.4 ELECTRICAL DISTRIBUTION & UTILIZATION EQUIPMENT IDENTIFICATION

A. General:
   1. All new and existing equipment modified by this project shall include arc-flash warning labels in accordance with NEC article 110.16.

B. All Panels, Motor Control Centers, Switchboards, Switchgear, Transformers, Etc.:
   1. Engraved nameplates identifying name of equipment, nominal voltage and phase of the equipment and where the equipment is fed from shall be installed on front surface of all panels, motor control centers, switchboards, switchgear, transformers, etc.:
      a. Ex: First Line: “NAME: RP-A”, Second Line: “120/208V-3Ø-4W”, Third Line: “FED FROM: PP-A CIR. 4 (IN MAIN ELEC ROOM)”
   2. Refer to Panelboard Specification Sections for additional labeling requirements (circuit directory cards, permanent circuit labels, permanent circuit numbers, etc.) required inside panelboards.

C. Safety/Disconnect Switches and Utilization Equipment (HVAC Equipment, Pumps, Powered Valves, Control Panels, Starters, Etc.)::
   1. Engraved nameplates identifying equipment being fed and where the equipment is fed from shall be installed on front surface of all disconnect switches (including both visible blade type switches and toggle-type switches) and on utilization equipment (where not clearly identified by immediately adjacent local disconnect switch):
      a. Ex: First Line: "RTU-6", Second Line: "FED FROM: PP-A CIR. 5"
   2. Where safety/disconnect switches are installed on the load side of variable frequency drives, the safety/disconnect switch shall be furnished with an additional engraved nameplate to read: "WARNING: TURN OFF VFD PRIOR TO OPENING THIS SWITCH".
   3. Safety/Disconnect switches feeding equipment that is fed from multiple sources (such as motors with integral overtemperature contacts that are monitored via a control system) and Utilization Equipment fed from multiple sources shall be furnished with an additional BLACK-ON-YELLOW engraved nameplate to read: "WARNING: ASSOCIATED EQUIPMENT FED FROM MULTIPLE SOURCES – DISCONNECT ALL SOURCES PRIOR TO OPENING COVER".

D. Emergency Systems:
   1. A sign shall be placed at the service entrance equipment (and at any remote shunt trip operators, or similar, for service equipment) indicating the type and location of on-site emergency power sources (such as generators, central battery systems, etc.) per NEC requirements.
   2. All boxes and enclosures (including transfer switches, generators, power panels, junction boxes, pullboxes, etc.) dedicated for emergency circuits shall be permanently marked with white-on-red engraved nameplates so they will be readily identified as a component of an emergency circuit or system.
   3. Where an Essential Electrical System (EES) is installed, all enclosures, raceways and equipment that are components of the EES shall be readily identified as such. Raceway shall be identified at intervals not exceeding 25 ft.

E. Services:
   1. All Service Equipment:
      a. Engraved nameplates identifying maximum available fault current, including date the fault current calculation was performed, in accordance with NEC article 110.24.
         1) Ex: First Line: "AVAILABLE FAULT CURRENT: 16,154 AMPS", Second Line: "DATE CALCULATED: JULY 8, 2013"
      b. All service entrance equipment shall be clearly labeled as being service entrance rated.
   2. Where a building or structure is supplied by more than one service (or any combination of branch circuits, feeders and services), a permanent plaque or directory shall be installed at each service disconnect location denoting all other services, feeders & branch circuits supplying that building or structure and the area served by each, per NEC requirements.

F. Generators:
   1. Generators shall be labeled with engraved nameplates identifying name of equipment.

3.5 INSTRUMENT AND CONTROL DEVICE IDENTIFICATION

A. New Instruments and control devices (whether furnished by contractor or not) shall be labeled with black-on-white engraved nameplates permanently affixed to the equipment or to the adjacent, readily-visible mounting surface with silicone adhesive or stainless steel wire ties.
   1. Instruments and process control devices (float switches, etc.) shall be labeled with instrument name and, where available, instrument ID number.
   2. Pushbutton stations shall be labeled with equipment being controlled. Labels shall be installed on front surface (or adjacent mounting surface) of all pushbutton stations.
   3. Thermostats and other similar HVAC control devices installed in process areas shall be labeled with equipment being controlled. Labels shall be installed on front surface (or adjacent mounting surface) of all thermostats and other similar HVAC control devices.

3.6 RACEWAY IDENTIFICATION

A. Each exposed raceway shall be labeled at the point where it becomes concealed, such as where it enters a concrete floor slab, a concrete wall, the ground, etc.

B. Each raceway entering in-grade or on-grade pullboxes/junction boxes, where the conduits are only visible inside the box, shall be labeled within the box at the point where the raceway becomes concealed.

C. Raceway nameplates shall identify:
   1. The location of the other end of the raceway (“TO MCC-1” or similar). If the other end of the raceway is at an intermediate, named pullbox (“INSTRUMENTATION PULLBOX #4” or similar), that pullbox name shall be labeled rather than the endpoint of the circuitry.

3.7 OTHER IDENTIFICATION

A. Factory-engraved coverplates identifying functions of light switches and other similar devices shall be installed where so required by plans/specifications.

END OF SECTION 16075

SECTION 16110

RACEWAYS

PART 1 GENERAL

1.1 DESCRIPTION

A. THE WORK UNDER THIS SECTION INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING:
1. Conduits
2. Conduit Fittings
3. Couplings & Connectors
4. Bushings
5. Raceway Hardware, Conduit Clamps & Supports
6. Watertight Entrance Seal Devices

PART 2 PRODUCTS

2.1 CONDUITS

A. PVC-Coated Rigid Steel:
1. The PVC coated rigid metal conduit must be UL Listed. Hazardous location fittings, prior to plastic coating must be UL listed. All conduit and fittings must be new, unused material. Applicable UL standards may include: UL 6 Standard for Safety, Rigid Metal Conduit, UL514B Standard for Safety, Fittings for Conduit and Outlet Boxes.
2. The PVC-coated rigid metal conduit shall be ETL PVC-001 listed.
3. The conduit shall be hot dip galvanized inside and out with hot galvanized threads.
4. Form 8 Condulets®, 3/4" through 2" diameters, shall have a tongue-in-groove “V-Seal" gasket to effectively seal against the elements. The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 in. of mercury (vacuum) for 72 hours shall be available.
5. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.
6. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating from tool damage during installation.
7. Form 8 Condulets® shall be supplied with plastic encapsulated stainless steel cover screws.
8. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness. Conduit or fittings having areas with thin or no coating shall be unacceptable.
9. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30deg.F (-1deg.C).
10. All male threads on conduit, elbows and nipples shall be protected by application of a urethane coating.

11. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.
12. Independent certified test results shall be available to confirm coating adhesion per ETL PVC-001 standards under the following conditions:
    a. Conduit immersed in boiling water with a minimum mean time to adhesion failure of 200 hours. ASTM D870)
    b. Conduit and condulet exposure to 150deg F (65deg C) and 95% relative humidity with a minimum mean time to failure of 30 days. (ASTM D11513.
    c. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test (ASTM D3359).
    d. No trace of the internal coating shall be visible on a white cloth following six wipes over the coating which has been wetted with acetone (ASTM D1308).
    e. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1.
    f. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.
13. Water tight flex connectors used in areas where PVC coated metal conduit is utilized shall be PVC coated also.
14. Shall be as manufactured by Perma-Cote, Plastibond, Korkap, Ocal or Okote.

B. Rigid Galvanized Steel and I.M.C.:
1. Shall be galvanized outside and inside by hot dipping.
2. Shall be as manufactured by Republic, Wheatland, Triangle, Pittsburg Standard, Youngstown, Allied or equal.

C. E.M.T.:
1. Shall be Electro-Galvanized.
2. Shall be as manufactured by Republic, Wheatland, Triangle, Pittsburg Standard, Youngstown, Allied or equal.

D. Rigid Aluminum:
1. Shall be manufactured of 6063 Alloy, T-1 temper.
2. Shall be as manufactured by Republic, Wheatland, Triangle, Pittsburg Standard, Youngstown, Allied or equal.

E. Schedule 40 and 80 PVC:
1. Shall be composed of polyvinyl chloride and shall be U.L. rated type 40 or 80 for use with 90 degree rated conductors. Conduit shall conform to NEMA Standards and applicable sections of N.E.C.
2. The conduit manufacturer shall have had a minimum of 5 years experience in the manufacture of the products. Non-metallic raceways shall be as manufactured by Carlon, Triangle, Can-Tex, Allied or equal.

F. HDPE Innerduct
1. Shall be composed high density polyethylene and shall be orange in color, unless noted otherwise.
2. Shall be corrugated unless noted otherwise.
3. Shall be manufactured by Carlon, Ipex or equal.

G. Flexible Metallic Conduit:
   1. Shall be continuous spiral wound and interlocked galvanized material, code approved for grounding.

H. Liquidtight Flexible Metallic Conduit:
   1. Shall be galvanized steel-core sealtite, code approved for grounding.
   2. Shall have an outer liquidtight, nonmetallic, sunlight-resistant jacket over an inner flexible metal core.
   3. Shall be as manufactured by Electric-Flex, Anaconda or equal.

2.2 FITTINGS, COUPLINGS & CONNECTORS

A. Rigid Galvanized Steel and I.M.C. couplings and connectors shall be standard threaded type, galvanized outside and inside by hot dipping. Threadless and clamp type are not acceptable. Couplings/connectors shall be as manufactured by Raco, Efcor, or Appleton or equal.

B. All fittings, conduit bodies, couplings and connectors (**including, but not limited to, condulettes, conduit couplings, connectors, hubs, nipples, unions, expansion fittings, explosion proof seal-offs, threaded hole closures, and seal-tight connectors, etc.**) used in areas where PVC-Coated Rigid conduit is used shall also be PVC-coated.

C. All fittings, conduit bodies, couplings and connectors (**including, but not limited to, condulettes, conduit couplings, connectors, hubs, nipples, unions, expansion fittings, explosion proof seal-offs, threaded hole closures, and seal-tight connectors, etc.**) installed in other wet, exterior or process areas where PVC-coated conduit systems are not required, shall be aluminum or stainless steel type. Standard steel fittings will not be acceptable.

D. All rain tight connectors shall be threaded Myers or approved equal, rated for outdoor application.

E. E.M.T. couplings and connectors shall be set screw, or steel compression type. All couplings and connectors shall be 720B, 730, 750B, or 760 series of Efcor or equal series of Raco. Pressure indented type connectors or cast metal will not be approved for any location. E.M.T. couplings and connectors shall be as manufactured by O-Z/Gedney, T&B, Efcor, Raco, Midwest or equal. E.M.T. fittings, couplings and connectors located within concrete (where allowed) shall be compression type and shall be adequately sealed with tape to ensure a concrete-tight seal.

F. Rigid Aluminum couplings and connectors shall be standard threaded type, of the same alloy as the associated conduit. Threadless and clamp type are not acceptable. Fittings shall be as manufactured by Thomas & Betts, Crouse-Hinds, Appleton, Pyle-National or equal.

G. All PVC couplings, adapters, end bells, reducers, etc., shall be of same material as conduit.

H. Liquidtight Flexible Metallic Conduit connectors shall be liquidtight with insulating throat or end bushing, designed for application with Liquidtight Flexible Metallic Conduit. Fittings shall be as manufactured by Efcor, Raco, Midwest or equal.

I. All LB unilets sizes 1 ¼" or larger shall have rollers.

J. Miscellaneous conduit fittings shall be as manufactured by Appleton, Crouse-Hinds, Pyle-National, Russell & Stoll or equal.

2.3 BUSHINGS

A. All non-grounding rigid bushings 1-1/4" and larger shall be the insulating type (O-Z/Gedney type "BB" or equal by T&B, Midwest Electric or Penn Union).

B. All non-grounding rigid bushings 1" and smaller shall be threaded malleable iron with integral noncombustible insulator rated for 150°C. Non-grounding rigid conduit bushings shall be O-Z/Gedney type "B" or equal by T&B, Midwest Electric or Penn Union.

C. All grounding rigid bushings shall be threaded malleable iron with integral noncombustible insulator rated for 150°C. All grounding rigid conduit bushings shall be O-Z/Gedney type "BLG" or equal by T&B, Midwest Electric or Penn Union.

2.4 HARDWARE, CONDUIT CLAMPS AND SUPPORTS

A. All hardware such as expansion shields, machine screws, toggle bolts, "U" or "J" bolts, machine bolts, conduit clamps and supports shall be of corrosion resistant materials (stainless steel, aluminum, galvanized or plated steel, or other approved materials).

B. Hardware in contact with aluminum handrails, plates or structural members and all hardware in exterior, wet or corrosive areas shall be type 316 stainless steel or aluminum (with bitumastic paint coating to isolate aluminum from contact with concrete where necessary) unless specifically noted otherwise.

C. Supports in exterior, process, wet or corrosive locations shall be type 316 stainless steel or aluminum (with bitumastic paint coating to isolate aluminum from contact with concrete where necessary) unless specifically noted otherwise.

D. Supports in extremely corrosive environments (such as chlorine or fluoride storage rooms) shall be PVC-Coated steel unless specifically noted otherwise.

E. Hardware and conduit clamps shall be as manufactured by Efcor, Steel City, G.A., Tinnerman or equal.

2.5 WATERTIGHT ENTRANCE SEAL DEVICES

A. For new construction, seal devices shall consist of oversized sleeve and malleable iron body with sealing rings, pressure rings, sealing grommets and pressure clamps as required (O-Z/Gedney type FSK/WSK or equal).

B. For cored-hole applications, seal devices shall consist of assembled dual pressure disks with neoprene sealing rings and membrane clamps as required (O-Z/Gedney type CSM or equal).

PART 3 EXECUTION

3.1 RACEWAY APPLICATION

A. Minimum Diameter: 3/4-inch.

B. Raceway Type: Raceway types shall be as specified below, unless indicated otherwise on drawings:
   1. Exterior, Exposed: Rigid Aluminum unless otherwise noted.
   2. Exterior, Used for Instrumentation Circuits: See Below.
   3. Other Exterior (Concrete-Encased or Direct Earth Buried): Schedule 40 PVC. PVC conduit shall convert to metallic conduit prior to exiting concrete-encasement or direct earth burial. See "transition" items below for additional requirements. Conduits shall be left exposed until after Engineer's observation.
   4. Interior, Exposed:
      a. Hazardous Locations: Rigid Aluminum .
      b. Wet Locations (including, but not limited to, Pump Rooms, Areas with exposed piping, Dewatering Rooms, Wet Wells, Underground Vaults, and other similar locations): Rigid Aluminum .
      c. Dry Locations: Rigid Aluminum.
      d. Extremely Corrosive Locations (Chlorine Storage Rooms, Fluoride Storage Rooms and other similar areas): Schedule 80 PVC.
   5. Interior, Concealed:
      a. Embedded inside Poured Concrete Walls, Ceilings or Floors, with a minimum of 2" of concrete between finished surface and outer wall of conduit on all sides, where no anchor bolts, screws or other similar items will be installed: Schedule 40 PVC. PVC conduit shall convert to metallic conduit (exact type as specified elsewhere within this section) prior to exiting poured concrete-encasement of wall, ceiling, floor or ductbank. See "transition" items below for additional requirements.
      b. Other Raceways Embedded inside Poured Concrete Walls, Ceilings or Floors (not meeting requirements above): PVC-Coated Rigid Steel
      c. Other Raceways: E.M.T.
   6. Raceways used for Instrumentation Circuits:
      a. Typical Dry or Wet Locations: Rigid Aluminum .
      b. Underground or Locations Embedded inside Poured Concrete: PVC-Coated Rigid Steel.
      c. Extremely Corrosive Locations (Chlorine Storage Rooms, Fluoride Storage Rooms and other similar areas): PVC-Coated Rigid Steel.
   7. Terminations at motors, transformers and other equipment which has moving or vibrating parts:
      a. Exterior or Wet Locations (including, but not limited to, Pump Rooms, Wet Wells, Underground Vaults, and other similar locations): Liquidtight Flexible Metallic Conduit (shall generally not exceed 24 inches in length) with watertight fittings.
      b. Dry, Interior Locations: Flexible Metallic Conduit (shall generally not exceed 24 inches in length).
   8. Terminations at instruments:
      a. Liquidtight Flexible Metallic Conduit (shall generally not exceed 12 inches in length) with watertight fittings.
   9. Terminations at fixtures mounted in grid-type ceilings:

a. Flexible Metallic Conduit or MC cabling (shall generally not exceed 72 inches in length and shall run from junction box to fixture, not from fixture to fixture).

10. Transition from underground or concrete-encased to exposed:
    a. Convert PVC to PVC-Coated Rigid Steel utilizing PVC-Coated Rigid Steel 90 degree bends (and vertical conduits as required by application) prior to exiting concrete/grade (except at outdoor pull boxes and under freestanding electrical equipment, where terminations shall be by PVC end bells installed flush with top of slab). Exposed portions of these coated conduits shall extend a minimum of 6" above floor level, and shall be installed at uniform heights.

3.2 RACEWAY INSTALLATION

A. General:

1. Follow methods which are appropriate and approved for the location and conditions involved. Where not otherwise shown, specified, or approved in a particular case, run all wiring concealed.
2. Where conduit crosses a structural expansion joint an approved conduit expansion fitting shall be installed.
3. Where any run of rigid aluminum conduit (including bends) exceeds 50' in length, an approved conduit expansion fitting shall be installed (beginning at center of run) at intervals not to exceed 50' on center.
4. A non-conductive polypropylene pull string, properly tied/secured at either end, shall be installed in all empty conduits.
5. Metal conduit field-cuts shall be cut square with a hacksaw and the ends reamed after threading.
6. PVC conduit field-cuts shall be made with hacksaw, and ends shall be deburred.
7. All PVC joints shall be made as follows:
    a. Clean the outside of the conduit to depth of the socket, and the inside of socket with an approved cleaner.
    b. Apply solvent cement as recommended by the conduit manufacturer to the interior of the socket and exterior of conduit, making sure to coat all surfaces to be joined.
    c. Insert conduit into the socket and rotate 1/4 to 1/2 turn and allow to dry.
8. All metallic conduit installed below grade or within concrete shall be coated with two (2) spiral-wrapped layers of 3M Scotchrap 50 PVC tape or two coats of asphaltum paint prior to installation.
9. Install ground wire sized per N.E.C. Table 250.122 in all conduits.
10. Use of running threads is absolutely prohibited. Conduit shall be jointed with approved threaded conduit couplings. Threadless and clamp type not acceptable.
11. Conduits shall be sized in accordance with latest National Electrical Code except when size shown on drawings.
12. Exposed, field-cut threads on all metal conduits shall be painted with zinc primer (for Galvanized Rigid or I.M.C.) or urethane paint (for PVC-Coated Rigid Steel) as recommended by conduit manufacturer .
13. Installation of PVC coated conduit systems shall be performed in strict accordance with the manufacturer's installation instructions. Damage to PVC coated conduit coating shall be touched up with patching compound as directed by manufacturer. To assure correct installation, the installer shall be certified by the manufacturer to install coated conduit.

B. Routing/Locating:

1. Exposed conduit runs shall be run level and plumb and shall, on interior of buildings, be run parallel and/or at right angles to building walls and/or partitions.
2. Conduit with an external diameter larger than 1/3 the thickness of a concrete slab shall not be placed in the slab. Conduits in slab shall not be spaced closer than 3 diameters on center.
3. Conduit run in ceiling spaces shall be run as high as possible, all at same level, and shall be supported from building structure. Do not support conduit from any other installation.
4. Conduit run within exterior CMU, concrete or other similar walls shall be run within the CMU cells / concrete structure / etc. Conduits shall not be run on the outside surface of CMU cells / concrete structure / etc. underneath exterior veneers / etc., which could cause a thermal break in the wall insulation or a future water intrusion problem.
5. Install conduit runs to avoid proximity to steam or hot water pipes. In no place shall a conduit be run within 6" of such pipes except where crossing is unavoidable, then conduit shall be kept at least 3" from the covering of the pipe crossed.
6. Before installing raceways for motors, HVAC equipment and other fixed equipment, check location of all equipment connections/terminal boxes with equipment supplier and locate and arrange raceways appropriately.
7. No conduit for instrumentation shall be run closer than 12 inches to parallel power conduits.
8. A minimum of 12" of clearance (or more as required by associated utility companies) shall be provided between the finished lines of exterior, underground conduit runs and exterior, underground utilities (gas, water, sewer, etc.).
9. Where any portion of raceway is installed in a wet environment (such as below grade) and located at a higher elevation than the raceway termination point in a dry environment, install watertight compound inside raceway at termination around cabling to prevent transfer of water through conduit system. Watertight compound shall be rated for the potential water head pressure, based on the assumption that ground water level would be at grade level.

C. Bends:

1. Do not make bends (in any raceway, including flexible conduits) that exceed allowable conductor bending radius of cable to be installed or that significantly restrict conductor flexibility.
2. All bends within concrete-encased ductbanks installed in exterior locations shall be long radius bends (24" minimum bending radius – varies with conduit diameter).
3. All bends in raceways containing multi-conductor power cables (such as shielded VFD cables) shall be long radius bends (24" minimum bending radius – varies with conduit diameter).
4. Where numerous exposed bends or grouped together, all bends shall be parallel, with same center and shall be similar in appearance
5. All PVC elbows, bends, etc., shall be either factory bends or made with an approved heat bender.

D. Support:

1. Anchor conduit securely in place by means of approved conduit clamps, hangers, supports and fastenings. Arrangement and methods of fastening all conduits shall be subject to Engineer's direction and approval. All conduits shall be rigidly supported (wire supports may not be used in any location). Use only approved clamps on exposed conduit.
2. Rigid Aluminum Conduits shall be supported at intervals not to exceed 5' on center.
3. Conduit in riser shafts shall be supported at each floor level by approved clamp hangers.
4. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameters of conduits.
5. Where installed in seismic zones, suspended raceways shall be braced in two (2) directions as required to prevent swaying and excessive movement.
6. Raceways installed on top of flat roofing shall be supported a minimum of 3 ½" above roof with rubber block supports (Cooper B-Line Dura-Blok or equal). Installation shall be in strict accordance with support manufacturer's instructions and recommendations.

E. Terminations:
1. All conduit connections to sheet metal cabinets or enclosures located in exterior or wet locations shall terminate by use of rain tight (Meyers) hubs.
2. In wet, exterior or process areas, conduits shall NOT enter tops of enclosures. All conduits shall enter enclosures from bottom, left or right sides of the enclosure (utilizing rain-tight Meyers hubs as indicated above).
3. Where rigid or I.M.C. conduits enter sheet metal boxes, they shall be secured by approved lock nuts and bushings.
4. Where metal conduits enter outdoor pull boxes, manholes, under freestanding electrical equipment or other locations where direct metal-to-metal contact does not exist between enclosure and conduit, grounding bushings shall be installed. Each grounding bushing shall be connected to the enclosure ground and all other grounding bushings with properly sized grounding conductors.
5. Where E.M.T. enters sheet metal boxes they shall be secured in place with approved insulating fittings.
6. Where PVC enters outdoor pull boxes, manholes or under freestanding electrical equipment, PVC end bells shall be installed.
7. Contractor shall be responsible for coordinating required conduit sizes with equipment hubs/conduit entry provisions (such as at motor tap boxes) prior to installation of conduit systems. Contractor shall field adjust final conduit sizes at terminations where so required (only as allowed by code) from those indicated on plans to coordinate with equipment hubs/conduit entry provisions.
8. Where conduit terminates in free air such that associated cabling/circuitry becomes exposed (such as at cable trays, etc.), conduit shall generally terminate in a horizontal orientation (to prevent dust/debris/etc. from entering conduit system). Where vertical conduit termination is necessary, the termination shall be provided with cord-grip conduit terminations to seal the conduit system.
9. Conduit ends shall be carefully plugged during construction.
10. Permanent, removable caps or plugs shall be installed on each end of all empty raceways with fittings listed to prevent water and other foreign matter from entering the conduit system.

F. Penetrations:

1. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly. Refer to drawings and other specifications for additional requirements.
2. All penetrations shall be at right angles unless shown otherwise.
3. Structural members (including footings and beams) shall not be notched or penetrated for the installation of electrical raceways unless noted otherwise without specific approval of the structural engineer.
4. Dry-packed non-shrink grout or watertight seal devices shall be used to seal openings around conduits at all penetrations through concrete walls, ceilings or aboveground floors.
5. All raceways entering structures, or where water is otherwise capable of entering equipment/devices through the raceway system, shall be sealed (at the first box or outlet) with foam duct sealant to prevent the entrance of gases or liquids from one area to another or into equipment/devices.
    a. Where the elevation of the raceway penetration (into the structure) is no more than 15' below the other (higher) end of the same raceway, Polywater FST sealant (rated to hold back up to 22' of continuous water head pressure), or pre-approved equal, shall be used.
    b. Where the elevation of the raceway penetration (into the structure) is between 15' and 75' below the other (higher) end of the same raceway, Polywater PHRD Custom Mechanical Seals (rated to hold back up to 36psi or 83' of continuous water head pressure), or pre-approved equal, shall be used.
    c. Where the elevation of the raceway penetration (into the structure) is more than 75' below the other (higher) end of the same raceway, the contractor shall propose a custom solution designed to hold back or to drain the possible water within the associated raceway. Submittals shall be provided to the engineer for review/approval, including a summary of the anticipated elevations/PSIs, details of the proposed installation, cut-sheets of devices/materials, etc.
6. Additionally, where necessary to ensure that water does not enter equipment/devices through the raceway system (where raceways extend to equipment/devices from wet areas), junction boxes with drain assemblies in bottom shall be located at low point of raceway system near equipment/devices (to drain water out of raceway system before it enters equipment/devices). Contractors shall provide drains in raceway systems where so necessary to prevent water entry into equipment/devices. In special applications (such as to instruments, etc.,), where cabling rated for exposed application is provided, contractor may propose short air gaps (approximately 6" or less) between the end of the conduit system and the equipment/device cable entry (to be made with cable gland connectors) to prevent water in conduit system from entering equipment/devices in lieu of drained junction boxes.
7. All raceways passing through concrete roofs or membrane-waterproofed walls or floors shall be provided with watertight seals as follows:
    a. Where ducts are concrete encased on one side: Install watertight entrance seal device on the accessible side of roof/wall/floor as directed by equipment manufacturer.
    b. Where ducts are accessible on both sides: Install watertight entrance seal device on each side of roof/wall/floor as directed by equipment manufacturer.

8. All raceways passing through walls of rooms containing/storing noxious chemicals (chlorine, ammonia, etc.) or through hazardous locations shall be sealed with conduit seals (Crouse-Hinds type EYS or equal).
9. All raceways terminating into electrical enclosures/devices/panels/etc. located in hazardous locations shall be sealed with conduit seals (Crouse-Hinds type EYS, EZS or equal) within 18" of the termination.

G. Exterior Electrical Ductbanks:
1. Where exterior electrical concrete-encased ductbanks are indicated on drawings, conduit runs between buildings or structures shall be grouped in concrete-encased ductbanks as follows:
   a. A minimum of 3" of concrete shall encase each side of all ductbanks.
   b. A minimum of 1 ½" of separation shall be provided between each conduit within ductbanks. PVC spacers shall be installed at the necessary intervals prior to placement of concrete to maintain the required spacing and to prevent bending or displacement of the conduits.
   c. Top of concrete shall be a minimum of 30" below grade. A continuous magnetic marking tape shall be buried directly above each ductbank, 12" below grade.
   d. Exact routing of ductbanks shall be field verified and shall be modified as necessary to avoid obstruction or conflicts.
   e. Underground electrical raceways shall be installed to meet the minimum cover requirements listed in NEC Table 300.5. Refer to drawings for more stringent requirements.

END OF SECTION 16110

SECTION 16116

AUXILIARY SYSTEM CABLES, 0-50V

PART 1 GENERAL

1.1 DESCRIPTION

A. Cables rated for 0V-50V application

PART 2 PRODUCTS

2.1 GENERAL

A. Unless specified otherwise, all cables within the scope of this specification section shall:
1. Be rated for exposed cable tray installation.
2. Be plenum rated (Class 1 Control cabling and Instrumentation cabling installed in conduit or exposed in cable tray in non-plenum areas is not required to be plenum-rated).
3. Be UL-rated for the proposed application.
4. Be multi-conductor with overall outer sheath as required by the application. The insulation of each conductor within the overall multi-conductor cable shall be uniquely color-coded. Ground conductors (when provided) within the multi-conductor cable shall have green insulation. Conductors with green insulation shall not be used for conductors other than ground.
5. Utilize copper conductors.
6. Have wire gauge as required to limit voltage drop to acceptable limits determined by the system supplier and to meet all applicable code requirements.
7. Where installed underground, within slab-on-grade or in exterior locations, be rated for wet locations.
8. Where required for specific systems, meet the specific requirements (conductor quantity, wire gauge, insulation type, shielding, etc.) of the system supplier.

2.2 INSTRUMENTATION CABLING

A. In addition to above requirements, and unless specified otherwise, Instrumentation cabling shall:
1. Be #16AWG minimum.
2. Be rated for 300V.
3. Have aluminum foil shielding.
4. Have stranded, twisted conductors.
5. Have PVC insulation/jacket with ripcord.
6. Be manufactured by Belden, AlphaWire or General Cable.

2.3 CLASS 1 CONTROL CABLING (120VAC CONTROL CIRCUITS, ETC.)

A. In addition to above requirements, and unless specified otherwise, Class 1 control cabling shall:
1. Be rated for 600V.
2. Be industrial grade.
3. Have stranded conductors.
4. Have sunlight/oil-resistant PVC/Nylon insulation and jacket with ripcord.

5. Be manufactured by Belden, AlphaWire or General Cable.

2.4 CLASS 2 & 3 CONTROL CABLING (FED FROM CLASS 2 OR 3 POWER SUPPLIES)

A. In addition to above requirements, and unless specified otherwise, Class 2 & 3 control cabling shall:
   1. Be rated for 300V.
   2. Be shielded if so recommended by the system supplier/integrator.
   3. Have twisted conductors.
   4. Have plenum-rated insulation/jacket with ripcord.
   5. Be manufactured by AlphaWire, Belden, General Cable, Superior Essex or West Penn.

2.5 NETWORK CABLING

A. Furnish and install all Ethernet, Fiber Optic and Backbone Copper Telephone cabling in accordance with all BICSI requirements and in accordance with other applicable specification sections.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

A. Routing:
   1. All wires and cables shall be installed in conduit unless specifically noted otherwise. Where conduit is not otherwise required by contract documents, 0-50V Cabling located within concealed, accessible ceiling spaces (such as above lay-in ceilings) may be run without conduit if the following requirements are met:
      a. Cabling is plenum-rated, multi-conductor.
      b. Cabling is supported by cable tray or with J-hook supports on intervals not to exceed 5'-0" on center. Cabling shall be supported solely from the cable tray or j-hooks supported from the building structure, without using piping, ductwork, conduit or other items as supports.
      c. Cabling is neatly formed, bundled and tied with plenum-rated Velcro straps on intervals not to exceed 30" on center.
      d. Properly-sized conduit(s) are provided wherever cabling enters an inaccessible or exposed area (such as above gyp board ceilings, within walls or through walls).
      e. Cabling is not a part of a Fire Alarm System, Smoke Control System, Emergency Generator Control System or other life-safety related system.
   2. End bushings shall be provided on both ends of all raceway terminations.
   3. No splices shall be pulled into conduit.
   4. No cabling shall be pulled until conduit is cleaned of all foreign matter.

B. Penetrations:
   1. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly.
   2. For cabling not installed in conduit:
      a. Fire/smoke barrier penetrations shall be sealed utilizing an enclosed fire-rated pathway device (STI EZ Path or equal) containing a built-in fire

sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed or retrofitted without the need to remove or reinstall firestop materials. The pathway shall be UL Classified and tested to the requirements of applicable ASTM/UL1479 standards.

3. For cabling installed within conduit from endpoint to endpoint:
   a. Fire/smoke barrier penetrations shall sealed utilizing fire caulk or other equivalent firestop systems around perimeters of conduits per UL requirements.
4. For cabling installed within cable trays:
   a. Fire/smoke barrier penetrations shall be sealed with one of the following methods:
      1) Continuous cable tray through the penetration, with a combination of large firestop pillows and small firestop pillows contained, supported and secured (to prevent unauthorized removal) on both sides by aluminum wire mesh and firestop putty. Firestop pillows shall be STI Series SSB or equal and Firestop putty shall be STI Spec Seal or equal.
      2) Cable tray broken at the penetration, with fire/smoke barrier penetrations sealed utilizing an enclosed fire-rated pathway device (STI EZ Path or equal) containing a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed or retrofitted without the need to remove or reinstall firestop materials. The pathway shall be UL Classified and tested to the requirements of applicable ASTM/UL1479 standards.

C. Excess Cabling:
1. Excess cabling shall be neatly coiled within all junction boxes, pullboxes, wireways, etc. and at all terminations as required to allow future re-termination of cabling.

D. Terminations:
1. All conductors/cabling (including spare conductors) shall be properly terminated unless specifically directed otherwise. See below for general termination hardware requirements.
2. Cabling shall be neatly formed, bundled and tied at all terminations.

3.2 SPLICES/CONNECTIONS/TERMINATIONS:

A. Network Cabling:
1. Network and fiber optic cabling shall be continuous from endpoint to endpoint and shall not be spliced unless specifically noted otherwise.

B. Control Cabling:
1. Connections shall be made with T & B Sta-Kon wire joints EPT66M, complete with insulating caps. To be installed with WT161 Tool or C nest of WT11M Tool, Ideal Super - Nuts (not wire nuts), Ideal Wing Nuts, or Buchanan Elec.

Products B Cap or Series 2000 Pressure connectors complete with nylon snap on insulators to be installed with C24 pressure tool.

C. Shielded cabling:
   1. Unless directed otherwise by the system supplier, 0-50V cable shielding shall be grounded at the PLC/control panel end only (not at the field device end) with a termination kit as directed by the PLC/control panel supplier.
   2. Shielded cabling shall be continuous from endpoint to endpoint and shall not be spliced without prior written approval from the Engineer.

3.3 LABELING

A. Refer to Specification Section 16075 for all labeling requirements.

END OF SECTION 16116

SECTION 16120

POWER CONDUCTORS AND CABLES 51V-600V

PART 1 GENERAL

1.1 DESCRIPTION

A. Power Wires and Cables

B. Low Voltage Wires and Cables

PART 2 PRODUCTS

2.1 POWER WIRES AND CABLES - 600 VOLT

A. General: Conductors shall have current carrying capacities as per N.E.C. and with 600 volt insulation, #12 minimum except for controls and fixture wire. Conductors shall be copper.

B. General Application (see below for exceptions):
1. At or Below Grade (including within slab-on-grade):
   a. #8 or larger conductors:
      1) XHHW or RHH/RHW/USE stranded (in conduit).
   b. #10 or smaller conductors for circuits terminating at motors:
      1) THHN/THWN or XHHW stranded (in conduit).
   c. #10 or smaller conductors (excluding circuits terminating at motors):
      1) THHN/THWN or XHHW solid (in conduit).
2. Above Grade:
   a. #8 or larger conductors:
      1) THHN/THWN, XHHW or RHH/RHW/USE stranded (in conduit).
   b. #10 or smaller conductors for circuits terminating at motors:
      1) THHN/THWN, XHHW or RHH/RHW/USE stranded (in conduit).
   c. #10 or smaller conductors (excluding circuits terminating at motors):
      1) THHN/THWN, XHHW or RHH/RHW/USE solid (in conduit).
3. Power Wire and cable shall be as manufactured by Southwire, Rome, Encore Wire, American Insulated Wire, Okonite, Phelps-Dodge, Amercable, Aetna or approved equal.

C. VFD Cabling
1. Wiring/Cabling installed between each VFD (Variable Frequency Drive) and the associated motor shall be multi-conductor shielded VFD power cable with the following characteristics:
   a. Multi-conductor cable with three (3) power conductors and three (3) ground conductors
   b. Soft annealed flexible stranded copper conductors.
   c. 1kV cross-linked polyolefin insulation (to resist the potential reflected voltages experienced in 600VAC VFD applications).
   d. Metallic shielded providing 100% shield coverage
   e. Oil, abrasion, chemical & sunlight resistant thermosetting compound outer jacket.

f. Flexible TC-ER rated, UL listed for use in cable trays.
g. Equal to AmerCable #37-108VFD cable.

D. Class 1 Control Cabling (120VAC Control Circuits, Etc.)
1. Unless specified otherwise, Class 1 control cabling shall:
a. Be rated for exposed cable tray installation.
b. Be plenum rated (Class 1 Control cabling and Instrumentation cabling installed in conduit or exposed in cable tray in non-plenum areas is not required to be plenum-rated).
c. Be UL-rated for the proposed application.
d. Be multi-conductor with overall outer sheath as required by the application. The insulation of each conductor within the overall multi-conductor cable shall be uniquely color-coded. Ground conductors (when provided) within the multi-conductor cable shall have green insulation. Conductors with green insulation shall not be used for conductors other than ground.
e. Utilize copper conductors.
f. Have wire gauge as required to limit voltage drop to acceptable limits determined by the system supplier and to meet all applicable code requirements.
g. Where installed underground, within slab-on-grade or in exterior locations, be rated for wet locations.
h. Where required for specific systems, meet the specific requirements (conductor quantity, wire gauge, insulation type, shielding, etc.) of the system supplier.
i. Be rated for 600V.
j. Be industrial grade.
k. Have stranded conductors.
l. Have sunlight/oil-resistant PVC/Nylon insulation and jacket with ripcord.
2. Control cabling shall be as manufactured by Belden, AlphaWire or General Cable.

2.2 WIRE CONNECTIONS:

A. All connector types:
1. Shall be properly rated for the proposed application by UL and per the manufacturer.

B. At Motor Connections (within motor terminal boxes):
1. On Unshielded Wire:
a. Single conductor per phase: shall be made with insulated set screw connectors or 3M 5300 Series 1kV Motor Lead Connections kits with mechanical lugs as required.
b. Multiple conductors per phase: shall be made with insulated mechanical lugs, rated for the associated motor cable types, by Polaris or Ilsco.
2. On Shielded Power Wire:
a. The braided shields and internal grounding conductors of shielded power (not instrumentation) cables shall be grounded at BOTH ends (at VFD/starter and at motor) with a termination kit provided by the cable supplier. This termination kit shall include a connection ring that makes

contact around the full circumference of the braided shield, and connects all internal grounds to a common external ground point.

3. Cabling within motor terminal boxes shall be trained such as to prevent any splice/termination/connection kits from contacting inside edge(s) of the motor terminal boxes (to prevent chaffing of the insulation/splice/wiring which could lead to faults). Contractor shall carefully coordinate all required motor terminal box sizes to ensure proper capacity for all required conductors/splices.

C. Other Dry locations:
1. On Wire larger than #10: shall be made with solderless, non-insulated compression-type connectors meeting requirements of Federal Specification WS-610e for Type II, Class 2 and shall be covered with Scotch #33 electrical tape so that insulation is equal to 150% of conductor insulation.
2. On Wire #10 and smaller: shall be made with one of the following:
   a. Ideal Wing Nuts or equal by 3M .
   b. Ideal Push-In Wire Connectors (for #12 and smaller only).

D. Other Wet/Damp locations:
1. On Wire larger than #10: shall be made with underground/direct-burial, waterproof rated EPDM or TPE-insulated connectors by Ilsco, Burndy or T&B.
2. On Wire #10 and smaller: shall be made with one of the following:
   a. Ideal Weatherproof or Underground Wire Connectors pre-filled with 100% silicone sealant as required by the application.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

A. All wires and cables shall be installed in conduit unless specifically noted otherwise.

B. All joints and splices on wire shall be made with solderless connectors, and covered so that insulation is equal to conductor insulation.

C. No splices shall be pulled into conduit.

D. No conductor shall be pulled until conduit is cleaned of all foreign matter.

E. Wire and cable shall be neatly formed, bundled and tied in all panelboards, wireways, disconnect switches, pullboxes, junction boxes, cabinets and other similar electrical enclosures.

F. All wires and cables installed in underground or other wet locations shall be rated by the manufacturer for wet locations.

G. Network cabling shall be continuous from endpoint to endpoint and shall not be spliced unless specifically noted otherwise.

H. All conductors/cabling (including spare conductors) shall be properly terminated unless specifically directed otherwise. See above for general termination hardware requirements.

3.2 POWER WIRE AND CABLE INSTALLATION:

A. No power conductor shall be smaller than #12 except where so designated on the drawings or hereinafter specified.

B. Multi-wire lighting branches shall be used as indicated.

C. Where more than three current-carrying conductors are installed in a single raceway or cable, conductors shall be derated as indicated in NEC Table 310.15(B)(3)(a).

D. Raceways/cables shall generally not be installed exposed to sunlight on roofs unless specifically required. Where raceways or cables are installed exposed to sunlight on roofs, conductors shall be derated with ampacities adjusted per NEC Table 310.15(B)(3)(c).

E. In installing parallel power conductors, it is mandatory that all conductors making up the feeder be exactly the same length, the same size, the same type of conductor with the same insulation. Each group of conductors making up a phase or neutral must be bonded at both ends in an approved manner.

F. In installing overhead main power services, a minimum of 5'-0" of cable per run shall be extended beyond the weatherhead(s) for connection to service drop. Confirm exact requirements with local utility company.

3.3 WIRE CONNECTIONS

A. See Part 2 above for material types.

B. Aluminum Wire Connections:
   1. Where aluminum wiring is allowed, connections shall utilize compression fittings, no exceptions (Anderson Versa Crimp or equal).

C. Any stranded wire connection to wiring devices shall be made with crimp type terminals.

D. All electrical connections and terminals shall be tightened according to manufacturer's published torque-tightening values with calibrated torque wrenches as required to clearly indicate final torque value to the contractor. Where manufacturer's torque values are not provided, those specified in UL 486A & 486B shall be used.

E. All connections and connector types shall be installed in strict compliance with all requirements of the connector manufacturer.

F. Under no condition shall the specified conductors be connected to terminals rated less than 75°C. Where conductors sized #1 or smaller are shown to be terminated at equipment and the terminals of that equipment are rated for less than 75°C, contractor shall install junction box near equipment to capture the specified conductors, splice with compression connections (rated for a least 75°C) and extend conductors with ampacity rating as required by NEC (based on terminal temperature rating) to equipment terminals. The length of the conductors to be terminated shall be as directed by the AHJ but not less than 48 inches.

3.4 SHIELDED CABLE INSTALLATION

A. Shielded VFD (power) cables:
   1. The braided shields and internal grounding conductors of shielded VFD (power) cables shall be grounded at BOTH ends (at VFD and at motor) with a termination kit provided by the cable supplier. This termination kit shall include a connection ring that makes contact around the full circumference of the braided shield, and connects all internal grounds to a common external ground point.
   2. Contractor shall coordinate the necessary size of conduit with the outer diameter of the proposed cable type to verify that the raceway loading does not exceed NEC requirements prior to rough-in of the conduit system.

B. Shielded instrumentation (low voltage) cables:
   1. The outer foil of shielded instrumentation cables shall be grounded at the PLC/control panel end only (not at the field device end) with a termination kit as directed by the PLC/control panel supplier.

3.5 LOW VOLTAGE (LESS THAN 50V) CONTROL AND NETWORK CABLE INSTALLATION:

A. All wires and cables shall be installed in conduit unless specifically noted otherwise. Low voltage control and/or network cabling located within concealed, accessible ceiling spaces (such as above lay-in ceilings) may be run without conduit if the following requirements are met:
   1. Cabling shall be plenum-rated, multi-conductor.
   2. Cabling shall be supported by cable tray or with J-hook supports on intervals not to exceed 5'-0" on center. Cabling shall be supported solely from the cable tray or j-hooks supported from the building structure, without using piping, ductwork, conduit or other items as supports.
   3. Cabling shall be properly bundled with plenum-rated Velcro straps on intervals not to exceed 30" on center.
   4. Properly-sized conduit(s) shall be provided wherever cabling enters an inaccessible or exposed area (such as above gyp board ceilings or through walls). End bushings shall be provided on both ends of all raceway terminations. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly.

3.6 CIRCUITS AND BRANCH CIRCUITS

A. Outlets shall be connected to branch circuits as indicated on drawings by circuit number adjacent to outlet symbols, and no more outlets than are indicated shall be connected to a circuit.

3.7 LABELING AND COLOR CODING OF WIRE AND CABLE

A. Refer to Specification Section 16075 for all labeling requirements.

B. A color coding system as listed below shall be followed throughout the network of branch power circuits as follows:

PHASE	120/208/240/ COLOR	120/240 HIGH LEG DELTA COLOR	277/480 VOLT COLOR
A	BLACK	BLACK	BROWN
B	RED	ORANGE (FOR HI-	ORANGE

		LEG)	
C	BLUE	BLUE	YELLOW
NEUTRAL	WHITE	WHITE	GRAY
GROUND	GREEN	GREEN	GREEN

C. Where dedicated neutrals are installed for multi-wire branch circuits, the neutral conductors shall be color coded as follows:

PHASE	120/208/240/ COLOR	120/240 HIGH LEG DELTA COLOR	277/480 VOLT COLOR
NEUTRAL A	WHITE W/ BLACK TRACER	WHITE W/ BLACK TRACER	GRAY W/ BROWN TRACER
NEUTRAL B	WHITE W/ RED TRACER	WHITE W/ ORANGE TRACER (FOR HI-LEG NEUTRAL)	GRAY W/ ORANGE TRACER
NEUTRAL C	WHITE W/ BLUE TRACER	WHITE W/ BLUE TRACER	GRAY W/ YELLOW TRACER

D. Control Conductors: Shall be color coded by use of colored “tracers”. No control circuit shall contain two identical conductors. For example, a set of five (5) control conductors for a pushbutton station represents one (1) control circuit which would require five (5) uniquely-colored control conductors.

3.8 TESTING

A. The insulation resistance of all feeder conductors (feeding electrical distribution equipment such as switchboards, panelboards, transfer switches, transformers, etc.) shall be tested at the load side of the feeder breaker with a 1000-volt DC Megger Tester prior to energization or final termination. Any feeder conductor with an insulation resistance less than the recommended minimums in the latest version of NETA Acceptance Testing Specification (“ATS”) standard shall be replaced by the contractor at the contractor’s expense. All final test results shall be clearly documented (with date, time, feeder, results, test equipment, etc.), and the final test results shall be submitted to the design team for review.

END OF SECTION 16120

SECTION 16130

OUTLET BOXES, JUNCTION BOXES, WIREWAYS

PART 1 GENERAL

1.1 DESCRIPTION

A. Outlet and Junction Boxes

B. Pull Boxes

C. Wireways

PART 2 PRODUCTS

2.1 OUTLET BOXES & JUNCTION BOXES (THROUGH 4-11/16")

A. Sheet Metal: Shall be standard type with knockouts made of hot dipped galvanized steel as manufactured by Steel City, Raco, Appleton, Bowers or equal.

B. Cast: Shall be type FS, FD, JB, GS, or SEH as required for application as manufactured by O-Z/Gedney, Appleton, or equal.

C. Nonmetallic: Shall be type Polycarbonate/ABS construction as required for application with non-metallic quick-release latches as manufactured by Hoffman, O-Z/Gedney, Appleton, or equal.

2.2 JUNCTION AND PULL BOXES (LARGER THAN 4-11/16")

A. Oil-Tight JIC: Shall be Hoffman Type CH box or approved equal.

B. Galvanized Cast Iron or Cast Aluminum: Shall be O-Z/Gedney or approved equal.

C. Stainless Steel: Shall be as manufactured by O-Z/Gedney, Hoffman or approved equal. Boxes shall have continuous hinges, seamless foam-in-place gaskets and screw-down clamps.

D. Nonmetallic: Shall be type Polycarbonate/ABS construction as required for application with non-metallic quick-release latches as manufactured by Hoffman, O-Z/Gedney, Appleton, or equal. Boxes shall have hinged covers and screw-down clamps.

E. Wireways: Shall be standard manufacturer's item as manufactured by Hoffman, Square "D", Burns, B & C or equal. Wireways shall have hinged covers and screw-down clamps.

F. Pre-cast Polymer Concrete Below-Grade Hand Holes & Pull Boxes:
   1. Enclosures, boxes and cover are required to be UL Listed and conform to all test provisions of ANSI/SCTE 77 "Specifications For Underground Enclosure Integrity" for Tier 15 applications (15,000lb design load and 22,500lb test load) unless noted otherwise.

2. All covers shall have a minimum coefficient of friction of 0.05 in accordance with ASTM C1028 and the corresponding Tier level shall be embossed on the top surface.
3. Cover shall be bolt-down include factory-labeling to read “Electric”, “Communications” or other as directed.
4. Hardware shall be stainless steel.
5. Shall be Quazite PG/LG Style or approved equal.

G. Above-Grade Padmounted Low Profile Pull Boxes:
1. Construction:
   a. 12Ga. stainless steel base with 12Ga aluminum top with brushed finish, and structural bracing as required.
   b. Continuous base frame with open bottom and eight (8) ½” x 1” slots for securing box to concrete pad below and a center support member.
   c. Two (2) full-size swing-open lids with full-length, stainless steel continuous hinges, lifting handles, key-locking provisions and provisions for latching lids in open position (with stainless steel chain or approved equal).
   d. Guides on lid and base frame as required to ensure proper closing of box and to provide increased security.
   e. Aluminum or stainless steel barrier between power & instrumentation areas within box if box is used for both power and instrumentation wiring.
   f. Other stainless steel hardware as required.
2. Minimum Dimensions:
   a. Power: 40 inches square x 18 inches high.
   b. Instrumentation: 24 inches square x 18 inches high.
3. Manufacturer:
   a. Electrical Enclosure Mfg. (Pell City, AL).
   b. Ebox (Pelham, AL).
   c. Approved Equal.

PART 3 EXECUTION

3.1 APPLICATION

A. General
1. All boxes and wireways shall be of sufficient size to provide free space for all enclosed conductors per NEC requirements. Fill calculations shall be performed by contractor per NEC requirements.

B. Outlet Boxes & Junction Boxes (through 4-11/16”)
   a. Sheet metal boxes shall be used on concealed work in ceiling or walls.
2. Cast boxes shall be used wherever Rigid or I.M.C. conduits are installed. Cast boxes shall be Cast Aluminum wherever installed in same locations as Rigid Aluminum conduit
3. All boxes installed in extremely corrosive areas (such as chlorine and fluoride storage rooms) where non-metallic raceways are used shall be non-metallic.

4. Except when located in exposed concrete block, switch and receptacle boxes shall be 4" square for single gang installation. Appropriate gang boxes shall be used for mounting ganged switches.
5. When installed in exposed concrete block, switch and receptacle boxes shall be square type designed for exposed block installation.
6. Ceiling outlet boxes shall be 4" octagon 1-1/2" deep or larger required due to number of wires.
7. Boxes installed in hazardous locations shall be explosion-proof rated for the associated application, constructed of copper-free cast aluminum.

C. Junction & Pull Boxes (larger than 4-11/16")
1. For all below grade exterior use and elsewhere as shown:
   a. In areas subject to future vehicular traffic: shall be galvanized cast iron (rated AASHTO H-20 Loading unless noted otherwise).
   b. In areas not subject to vehicular traffic: shall be galvanized cast iron or pre-cast polymer concrete (rated for Tier 15 Loading unless noted otherwise).
2. All boxes installed exposed in exterior or wet areas shall be stainless steel (NEMA 4X).
3. All boxes installed exposed in corrosive areas shall be stainless steel (NEMA 4X).
4. All boxes installed in extremely corrosive areas (such as chlorine and fluoride storage rooms) where non-metallic raceways are used shall be non-metallic.
5. Padmounted Pull Boxes shall be installed as shown on Plans or as required by project conditions. Transclosure-style Padmounted boxes shall be installed wherever required by the quantities and sizes of conductors. Contractor shall submit all Padmounted Pull Box types prior to ordering for engineer's review and comment.
6. Boxes installed in hazardous locations shall be explosion-proof rated for the associated application, constructed of copper-free cast aluminum.
7. All others shall be oil tight JIC box not less than 16 gauge.

3.2 INSTALLATION

A. General
1. All boxes and wireways shall be securely anchored.
2. All boxes shall be properly sealed and protected during construction and shall be cleaned of all foreign matter before conductors are installed.
3. All boxes and wireways shall be readily accessible. Contractor shall be responsible for furnishing and installing access panels per architect's specifications. Locations shall be as directed by the architect as required to make boxes, wireways, electrical connections, etc. accessible where above gypsum board ceilings or in other similar locations.
4. All metallic boxes and wireways shall be properly grounded.
5. Refer to Specification Section 16075 for identification requirements.

B. Outlet Boxes & Junction Boxes (through 4-11/16")
1. Boxes shall be provided with approved 3/8" fixture studs were required.
2. Recessed boxes for wiring devices, surface fixtures, or connections, shall be set so that the edge of cover comes flush with finished surface.

3. There shall be no more knockouts opened in any sheet metal box than actually used.
4. Any unused opening in cast boxes shall be plugged.
5. Back to back boxes to be staggered at least 3 inches.
6. Under no circumstances shall through-the-wall boxes be used.

C. Junction & Pull Boxes (larger than 4-11/16")
1. Pull boxes shall be installed as indicated on plans and/or as required due to number of bends, distance or pulling conditions.
2. Boxes to be imbedded in concrete shall be properly leveled and anchored in place before the concrete is poured.
3. All pull boxes and/or junction boxes installed exterior below grade, shall have their tops a minimum of 1-1/2 inches above surrounding grade and sloped so that water will not stand on lid. A positive drain shall be installed, to prevent water accumulation inside.
4. Above grade pull boxes shall be installed on concrete anchor bases as shown on Plans.

D. Wireways and/or wall-mounted equipment
1. Mount each wireway to channels of the same metal type as the wireway.
2. Conductors serving a wireway shall be extended without reduction in size, for the entire length of the wireway. Tap-offs to switches and other items served by the wireway shall be made with ILSCO type GTA with GTC cap.

END OF SECTION 16130

SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. Wiring Devices

B. Plates

C. Finishes

PART 2 PRODUCTS

2.1 WIRING DEVICES AND PLATES

A. Switches shall be AC type, extra-heavy duty industrial grade (unless otherwise shown) of ratings shown on drawings. Switches shall be as manufactured by Hubbell, P & S, Sierra, Bryant, GE, Arrow Hart or equal.

B. Receptacles shall have blade configuration and shall be heavy duty industrial grade (unless otherwise shown) of current and voltage rating as shown on drawings. Receptacles shall be as manufactured by Hubbell, P & S, Sierra, Bryant, GE, Arrow Hart or equal.

C. All GFCI-type receptacles shall continuously self-test and shall trip/deny power if the receptacle does not provide proper GFCI protection or if the line/load terminations are miswired and shall provide visual indication of power status, trip conditions, ground fault conditions and end-of-life status.

D. Each wiring device shall have a plate (see “Finishes” section below for specific requirements).

2.2 FINISHES

A. All wiring devices (switches, receptacles, etc.) shall be colored to match the coverplates described below. For instance, all items covered by stainless steel, aluminum or malleable iron plates shall be gray in color.

B. Coverplates for recessed, wall-mounted electrical items (switches, receptacles, telephone outlets, etc.) shall be stainless steel unless shown otherwise.

C. Coverplates, trim rings, etc. for recessed, floor-mounted electrical items (floor outlets, underfloor duct junctions, etc.) shall match finish of building hardware (302/304 stainless steel, brass, etc.) in area installed.

D. Coverplates for exposed electrical items (switches, receptacles, telephone outlets, etc.) shall be of same material as exposed boxes (see Outlet Box Specification for required material type) and shall have beveled edges.

E. Coverplates for receptacles in wet locations shall be metallic, in-use type, rated for wet locations per NEC requirements unless noted otherwise.

F. See “Electrical Identification” specification section for coverplate labeling requirements.

PART 3 EXECUTION

3.1 GENERAL MOUNTING

A. Symbols on drawings and mounting heights are approximate. The exact locations and mounting heights shall be determined on the job, and it shall be the Contractor's responsibility to coordinate with all trades to secure correct installation. For example, Contractor shall coordinate exact mounting heights over counters, in or above backsplashes, in block walls, and at other specific construction features.

B. Verify all door swings with Architectural. Locate boxes for light switches within four inches of door trim on swing side (not hinge side) of door.

C. Devices and associated plates shall not be used as support; outlet boxes shall be rigidly supported from structural members.

D. Mount all straight-blade receptacles vertically with ground pole up, unless specifically noted otherwise.

E. Unless otherwise shown or required by local handicap codes, outlet boxes shall be the following distances above the finished floor unless otherwise noted.
1. Receptacles and telephone outlets in offices and other finished areas: 1’-6” to the center of the box.
2. Receptacles and telephone outlets in equipment rooms and other unfinished areas: 4’-0” to the center of the box.
3. Receptacles over counters: As Noted
4. Switches, general: 4’-0” to the top of the box.
5. Push-button, etc., general: 4’-0” to the top of the box.
6. Other device types: verify with engineer prior to rough-in.

END OF SECTION 16140

SECTION 16231

GENERATOR SETS

PART 1 GENERAL

1.1 SCOPE

A. Provide complete factory assembled generator set equipment with digital (microprocessor-based) electronic generator set controls, digital governor, and digital voltage regulator.

B. Provide factory test, startup by a supplier authorized by the equipment manufacturer(s), and on-site testing of the system.

C. The generator set manufacturer shall warrant all equipment provided under this section, whether or not is manufactured by the generator set manufacturer, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.

1.2 CODES AND STANDARDS

A. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards, as applicable. The generator set shall include necessary features to meet the requirements of the latest editions of the following standards/codes where applicable:

1. CSA 282, 1989 Emergency Electrical Power Supply for Buildings
2. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
3. International Building Codes.
4. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
5. NFPA99 – Essential Electrical Systems for Health Care Facilities.
6. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.

B. The generator set and supplied accessories shall meet the requirements of the latest editions of the following standards where applicable:

1. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.
2. UL142 – Sub-base Tanks
3. UL1236 – Battery Chargers
4. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

C. The generator set and supplied accessories shall meet all applicable Environmental Protection Agency (EPA) TIER Emission Level or Emission Certification requirements and any local requirements in effect at the time the generator set is ordered (for the proposed location of the generator).

D. The control system for the generator set shall comply with the following requirements.
   1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
   2. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.
   3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
   4. FCC Part 15, Subpart B.
   5. IEC8528 part 4. Control Systems for Generator Sets
   6. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.
   7. UL508. The entire control system of the generator set shall be UL508 listed and labeled.
   8. UL1236 –Battery Chargers.

E. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.3 ACCEPTABLE MANUFACTURERS

A. Caterpillar

B. Cummins/Onan

PART 2 PRODUCTS

2.1 GENERATOR SET

A. Ratings
   1. The generator set assembly (including both the motor/engine assembly and the generator assembly) shall operate at 1800 rpm, and the generator shall produce a 60 Hz waveform.
   2. Voltage and phase ratings shall be as shown on plans.
   3. Minimum kW rating (and associated alternator sizing) shall be the greater of the following:
      a. Minimum kW rating listed on plans.
      b. Ratings required to provide skVA as follows (shall be documented with reports in submittals using generator sizing software described in Part 3 below):
         1) If so listed on plans, the step loads fed by the generator at voltage/frequency dip criteria specified.
         2) If so listed on plans, the skVA rating specified.
         3) If neither of the above are listed on plans, generator shall be sized to accommodate a block load of 100% of the Total Demand Load listed on plans, with a maximum voltage dip of 20% and a maximum frequency dip of 10%.
   4. kVA rating shall be 1.25 times the kW rating (based on .8 PF).
   5. Unless shown otherwise on plans, the generator set shall be rated based on the following site conditions:
      a. Altitude of project site.
      b. Ambient temperatures up to 120 degrees F.

6. The generator set rating shall be based on emergency/standby service unless noted otherwise.

B. Performance
1. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.5%.
3. The engine-generator set shall be capable of accepting a single step load of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
4. Minimum motor starting capability shall be as shown on plans. The generator set shall be capable of recovering to a minimum of 90% of rated no load voltage following the application of the specified skVA load at near zero power factor applied to the generator set. Maximum voltage dip on application of this load, considering both alternator performance and engine speed changes shall not exceed 20% unless shown otherwise on plans.
5. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3rd order harmonics or their multiples. Telephone influence factor shall be less than 40.
6. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning.

C. Construction
1. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.
2. The engine-generator set shall be rated for the seismic conditions for the installation location as mapped by the US Geological Survey and required by local building codes.
3. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3R enclosure. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

D. Connections
1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept compression terminations of the number and size as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
2. Power connections to auxiliary devices shall be made at the devices, with required overcurrent protection located at panelboard(s) external to the generator set unless shown otherwise on plans. Where a load center or panelboard is shown within the generator enclosure on the plans, this load center/panelboard shall be furnished with the generator and shall comply with the applicable panelboard and identification sections of this specification.

3. Generator set control interfaces to other system components shall be made on a permanently labeled terminal block assembly. Labels describing connection point functions shall be provided.

2.2 ENGINE AND ENGINE EQUIPMENT

A. The engine shall be diesel, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. Engine accessories and features shall include:

1. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed and operating in various isochronous or parallel states. The governing system shall include a programmable warm up at idle and cooldown at idle function. While operating in idle state, the control system shall disable the alternator excitation system.
2. Skid-mounted radiator and cooling system rated for full load operation in 120 degrees F (49 degrees C) ambient as measured at the generator air inlet. Radiator fan shall be suitable for use in a system with 0.5 in H_2O restriction. Radiator shall be sized based on a core temperature that is 20F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture prior to shipping. Rotating parts shall be guarded against accidental contact.
3. Electric starter(s) capable of three complete cranking cycles without overheating.
4. Positive displacement, mechanical, full pressure, lubrication oil pump.
5. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
6. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element. Fuel cooler, suitable for operation of the generator set at full rated load in the ambient temperature specified shall be provided if required for operation due to the design of the engine and the installation.
7. Replaceable dry element air cleaner with restriction indicator.
8. Flexible supply and return fuel lines.
9. Engine mounted battery charging alternator and solid-state voltage regulator.
10. Block heater
    a. Engine mounted, thermostatically controlled, block heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.
    b. The block heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The block heater installation shall be specifically designed to provide proper venting of the system. The block heaters shall be installed using quick disconnect couplers to isolate the heaters for replacement of the heater

element without draining the coolant from the generator set. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.

c. The block heater shall be provided with a DC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the block heater system.

d. The block heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 104F (40C) in a 40F (4C) ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification. If the heater quantities or wattage ratings are different than shown on plans, contractor shall be responsible for providing the properly-rated circuits (with circuit breakers) as required to the heater(s).

11. Provide vibration isolators, spring & pad type, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.

12. Starting and Control Batteries shall be calcium/lead antimony type, 24 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors. The batteries shall be capable of a minimum of three complete 15-second cranking cycles at 40F ambient temperature when fully charged.

13. Provide critical-grade exhaust silencer(s) for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. Exhaust system shall be installed according to the engine manufacturer's recommendations and applicable codes and standards.

14. A UL listed/CSA certified voltage regulated battery charger shall be provided for each engine-generator set. The charger shall be located at the generator unless shown otherwise on plans. Output amperage, Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Charger shall include an Analog DC voltmeter and ammeter, 12 hour equalize charge timer, and AC and DC fuses. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of:
    a. Loss of AC power - red light
    b. Low battery voltage - red light
    c. High battery voltage - red light
    d. Power ON - green light and N.O. relay contact

2.3 FUEL TANK

A. Refer to "Sub-Base Fuel Tank" Paragraph below for fuel tank requirements.

2.4 AC GENERATOR

A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system and shall be UL1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees Centigrade.

B. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

C. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

D. The subtransient reactance of the alternator shall not exceed 12 percent, based on the standby rating of the generator set.

2.5 GENERATOR SET CONTROL

A. 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.

B. The control shall be mounted on the generator set, or may be mounted in a free-standing panel next to the generator set if adequate space and accessibility is available. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

C. The generator set mounted control shall include the following features and functions:

1. 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. A separate push-button to initiate starting is acceptable. 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. The integrity of the generator remote start circuit shall be monitored for broken, disconnected or shorted wires. Loss of integrity shall start the generator.
    c. 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.
    d. 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.
    e. 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.
2. 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, power factor meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Meter scales shall be color coded in the following fashion: green shall indicate normal operating condition, amber shall indicate operation in ranges that indicate potential failure, and red shall indicate failure impending. Metering accuracy shall be within 1% at rated output.

b. The control system shall monitor the total load on the generator set, and maintain data logs of total operating hours at specific load levels ranging from 0 to 110% of rated load, in 10% increments. The control shall display hours of operation at less than 30% load and total hours of operation at more than 90% of rated load.

c. The control system shall log total number of operating hours, total kWH, and total control on hours, as well as total values since reset.

3. Generator Set Alarm and Status Display.

a. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright exterior day lighting conditions.

b. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. Conditions required to be annunciated shall include:

1) low oil pressure (warning)
2) low oil pressure (shutdown)
3) oil pressure sender failure (warning)
4) low coolant temperature (warning)
5) high coolant temperature (warning)
6) high coolant temperature (shutdown)
7) high oil temperature (warning)
8) engine temperature sender failure (warning)
9) low coolant level (warning or shutdown - selectable)
10) fail to crank (shutdown)
11) fail to start/overcrank (shutdown)
12) overspeed (shutdown)
13) low DC voltage (warning)
14) high DC voltage (warning)
15) weak battery (warning)
16) low fuel (warning)
17) high AC voltage (shutdown)
18) low AC voltage (shutdown)
19) under frequency (shutdown)
20) over current (warning)
21) over current (shutdown)
22) short circuit (shutdown)
23) ground fault (warning) (if genset breaker is rated 1000A or greater)
24) over load (warning)
25) Genset circuit breaker tripped (warning)
26) emergency stop (shutdown)

4. Engine Status Monitoring.

a. The following information shall be available from an analog status panel on the generator set control :

1) engine oil pressure (psi or kPA)
2) engine coolant temperature (degrees F or C)

3) battery voltage (DC volts)

5. 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.
   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 an actual failure conditions.
6. 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 an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, with local indication of setting level.
   b. Controls shall be provided to monitor the output current of the generator set and initiate an 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. This protection may be provided using a

microprocessor-based programmable relay system designed to protect the alternator system from damage, or using programmable electronic-trip LSI breaker(s), programmed/set by the generator supplier to ensure full protection of the alternator system.

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. When required by National Electrical Code or indicated on project drawings, the control System shall include a ground fault monitoring relay. The relay shall be adjustable from 3.8-1200 amps, and include adjustable time delay of 0-10.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay that will function correctly in system as installed.

7. Other Control Functions

a. The generator set shall communicate with the Automatic Transfer Switch via hardwired control connections as required.

b. The integrity of the generator remote start circuit shall be monitored for broken, disconnected or shorted wires. Loss of integrity shall start the generator.

c. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is out of acceptable limits. During engine cranking (starter engaged), the low voltage limit shall be disabled, and DC voltage shall be monitored as load is applied to the battery, to detect impending battery failure or deteriorated battery condition.

8. Dry Contacts/Relays for Remote Monitoring:

a. The control system shall provide ten (10) programmable output relays. These relay outputs shall be configurable for any alarm, shutdown, or status condition monitored by the control. Five (5) of these relays shall be preconfigured (and labeled accordingly) to indicate:
   1) generator set operating at rated voltage and frequency
   2) common warning
   3) common shutdown
   4) load shed command and
   5) low fuel warning.

b. A fused 20 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.

2.6 GENERATOR REMOTE MANUAL STOP STATION

A. Each generator set shall be furnished with a remote manual stop station of a type to prevent inadvertent or unintentional operation per NFPA 110 requirements.

B. Stop station pushbutton shall be red, non-illuminated, push-pull, mushroom-type, maintained-contact, 1 5/8" diameter, 30mm base, heavy-duty, oil-tight, water-tight unit) mounted within guarded enclosure to prevent inadvertent operation and labeled with engraved nameplate (white letters on red background) to read: "GENERATOR EMERGENCY STOP" (or similar with specific generator name where so identified on drawings).

C. Exact stop station type shall be coordinated with generator controls supplier to ensure a fully-functional system per NFPA 110 requirements.

2.7 GENERATOR MAIN LINE CIRCUIT BREAKER(S)

A. The generator set shall be provided with a mounted main line circuit breaker(s), sized as shown on plans. The circuit breaker(s) shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

B. The main line circuit breaker(s) shall be provided with auxiliary contacts to indicate trip/off alarm conditions to the generator set control system.

2.8 OUTDOOR WEATHER-PROTECTIVE ENCLOSURE

A. The generator set shall be provided with a weatherproof, sound-attenuated, outdoor enclosure, with the entire package listed under UL2200. The package shall comply with the requirements of the National Electrical Code for all wiring materials and component spacing. The total assembly of generator set, enclosure, and sub-base fuel tank (if applicable) shall be designed to be lifted into place using spreader bars. Housing shall provide ample airflow for generator set operation at rated load in an ambient temperature of 100F. The housing shall have hinged access doors as required to maintain easy access for all operating and service functions. All doors shall be lockable, and include retainers to hold the door open during service. Enclosure roof shall be cambered to prevent rainwater accumulation. Openings shall be screened to limit access of rodents into the enclosure. All electrical power and control interconnections shall be made within the perimeter of the enclosure.

B. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 76 dBA (including exhaust noise) at any location 7 meters from the generator set in a free field environment:

C. The enclosure shall include vertical air discharge hoods as required to redirect discharge air upwards and reduce noise accordingly.

D. The enclosure shall be insulated with non-hydroscopic materials.

E. The enclosure shall be rated for the wind and seismic conditions for the installation location as mapped by the US Geological Survey and required by local building codes.

F. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturers standard color using a two step electrocoating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating that meets the following requirements:
   1. Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.
   2. Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.
   3. Crosshatch adhesion, per ASTM D3359-93, 4B-5B.
   4. Impact resistance, per ASTM D2794-93, 120-160 inch-pounds.
   5. Salt Spray, per ASTM B117-90, 1000+ hours.
   6. Humidity, per ASTM D2247-92, 1000+ hours.
   7. Water Soak, per ASTM D2247-92, 1000+ hours.

G. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

H. Enclosure shall be constructed of minimum 12 gauge steel for framework and 14 gauge steel for panels. All hardware and hinges shall be stainless steel.

I. A factory-mounted critical exhaust silencer shall be installed inside the enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with a rain cap. Exhaust connections to the generator set shall be through seamless flexible connections.

J. The enclosure shall include the following maintenance provisions:
   1. Flexible coolant and lubricating oil drain lines, that extend to the exterior of the enclosure, with internal drain valves
   2. External radiator fill provision.

K. Provide a factory-mounted and wired electrical distribution panel to serve the generator set and enclosure. The provisions required include:
   1. 100-amp distribution panelboard installed inside enclosure and fed by a 120/208VAC power feeder installed by the contractor (unless shown otherwise on plans).
   2. Two duplex GFI receptacles, one inside the enclosure, and a weatherproof receptacle on the outside of the enclosure (all factory-wired).
   3. Two three-way switches controlling three AC lamps mounted in vapor tight and gasketted fixtures (all factory-wired).
   4. Factory-wired normal AC service from the panelboard to the engine coolant and alternator heaters, and battery charger.

2.9 SUB-BASE FUEL TANK

A. Provide a sub-base fuel tank for the generator set, sized to allow for full load operation of the generator set for 48 hours. The sub-base fuel tank shall be UL142 listed and labeled. Installation shall be in compliance to NFPA37. The fuel tank shall be a double-walled, steel construction and include the following features:
   1. Emergency tank and basin vents.
   2. Mechanical level gauge.

3. Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by the engine manufacturer and in compliance to UL2200 and NFPA 37 requirements.
4. Leak detection provisions, wired to the generator set control for local and remote alarm indication.
5. High and low level float switches to indicate fuel level. Wire switches to generator control for local and remote indication of fuel level
6. Basin drain.
7. Integral lifting provisions.

B. The equipment, as installed, shall meet all local and regional requirements for above ground tanks.

C. Where the generator design/layout, sub-base fuel tank height, and/or concrete housekeeping pad for the generator set causes any circuit breaker handle, control device, metering display or other similar item to be located higher than 6'-7" above finished floor, the supplier shall provide an aluminum grating platform complete with stairs and handrails meeting all applicable code requirements for proper access to these items. The platform and stairs shall be permanently mounted to a concrete base as recommended by the system supplier. Alternatively, the supplier may relocate (at the factory) these items to be below 6'-7" above finished floor.

2.10 SEQUENCE OF OPERATION

A. The maximum elapsed time allowed from loss of normal power to restoration of power to emergency circuits from generator through transfer switch shall be 10 seconds.

B. Generator set shall start upon receipt of a start signal from remote equipment. The start signal shall be via hardwired connection to the generator set control.
1. The integrity of the generator remote start circuit shall be monitored for broken, disconnected or shorted wires. Loss of integrity shall start the generator.

C. The generator set shall complete a time delay start period as programmed into the control.

D. The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:
1. The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set, and indicate "fail to crank" shutdown.
2. The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate "fail to start".
3. The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed, and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.

4. On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous, synchronize, load share, load demand or load govern state.

E. When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.

F. On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.

G. Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

PART 3 EXECUTION

3.1 SUBMITTALS.

A. Within 10 days after award of contract, provide six sets of the following information for review:

1. Manufacturer's product literature and performance data, sufficient to verify compliance to specification requirements.
2. A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.
3. Manufacturer's certification of prototype testing.
4. Manufacturer's published warranty documents.
5. Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
6. Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
7. Generator sizing software report(s) showing compliance with all specification requirements and any additional motor starting requirements indicated in contract documents.
8. Time-current-curves demonstrating that the generator alternator relaying or breaker protective device(s) provide proper protection for the alternator by a comparison of the trip characteristic of the breaker with the thermal damage characteristic of the alternator.
9. Manufacturer's installation instructions.

3.2 FACTORY TESTING.

A. The generator set supplier shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.

B. Factory testing may be witnessed by the owner and consulting engineer. Costs for travel expenses will be the responsibility of the owner and consulting engineer. Supplier is responsible to provide two weeks notice for testing.

C. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will

not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

3.3 INSTALLATION

A. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

B. Installation of equipment shall include furnishing and installing all interconnecting wiring, fuel lines, etc. between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

C. Generator equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

D. Remote stop station type, labeling and location shall be submitted by contractor to engineer and local fire marshal for approval prior to rough-in. Location shall be outside the room housing the prime mover (where so installed within a room) or elsewhere on the premises where the prime mover is located outside the building. Contractor shall provide all interconnections from remote stop station to generator set as required by generator set supplier for a fully-functional system.

E. Equipment shall be initially started and operated by representatives of the manufacturer.

F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

3.4 ON-SITE ACCEPTANCE TEST:

A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests.

B. Installation acceptance tests to be conducted on-site shall include the following (performed in accordance with NFPA 110):
   1. "Cold start" test.
   2. Four (4) hour full load test. Provide resistive load banks and make temporary connections as required.
   3. One step rated load pickup test.
   4. Power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

C. Upon completion of the manufacturer's site start-up and checkout, the contractor shall leave the diesel tank half full of fuel for use by the owner.

3.5 TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to not less than 5 persons. Training date shall be coordinated with the facility owner.

3.6 SERVICE AND SUPPORT

A. The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

B. The generator set shall be distributed and serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

C. The manufacturer of the generator set shall own, maintain and make available (to engineer, free of charge) generator set sizing software that calculates voltage dip, frequency dip, THDI and THDV of proposed generator/alternator set using the following inputs:
   1. Summary of step loads including load type (across-the-line motor, VFD, Fire Pump, Fluorescent Lighting, UPS, etc.).
   2. Generator Set Duty (Standby, Prime, Continuous).
   3. Maximum Ambient Temperature.
   4. Project site altitude.
   5. Generator Fuel type.
   6. Voltage/Phase/Frequency.

D. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

3.7 WARRANTY

A. The generator set and associated equipment shall be warranted for a period of not less than 2 years from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

END OF SECTION 16231

SECTION 16289

SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (<1000 V) power distribution and control equipment.

B. The specified unit(s) shall provide effective high energy transient voltage surge suppression, surge current diversion and high frequency noise attenuation in all electrical modes for equipment connected downstream from the facility's meter or load side of the main overcurrent device. The unit(s) shall be connected in parallel with the facility's wiring system.

C. The unit(s) shall be designed and manufactured in North America by a qualified manufacturer of suppression filter system equipment. The qualified manufacturer shall have been engaged in the commercial design and manufacturer of such products for minimum of ten (10) years.

D. All products that are submitted according to these specification will be required to meet this specification in it's entirety for both service and distribution TVSS systems. Any product that is submitted and does not comply with all parts of this specification will be subject to rejection.

1.3 DEFINITIONS

A. VPR: Voltage Protection Rating.

B. SPD: Surge Protective Device(s)

C. $I_{(n)}$: Nominal Discharge Current

1.4 SUBMITTALS

A. See specification section 16050.

B. Product Data: For each type of product indicated. Include:
1. Maximum Single Impulse Surge Current Rating.
2. Surge Life (Repetitive Surge) Rating.
3. UL1449 (Latest Edition) Voltage Protection Ratings (VPR).
4. UL1449 (Latest Edition) Nominal Discharge Current (In).
5. Product dimensions and weights.
6. Furnished specialties and accessories.

C. Qualification Data:

D. Safety Agency File Number.

E. ISO 9001-2008 Certification.

F. ISO 1401-2001 Certification.

G. Operation and Maintenance Data: For SPDs to include all submittal data and any applicable operation and maintenance manuals.

H. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

B. The unit shall be UL 1449 Listed and CUL Approved as a Surge Protective Device and UL 1283 Listed as an Electromagnetic Interference Filter

C. Provide 2nd party certified data demonstrating SPD response to ANSI/IEEE C62.41.2-2002 standard waveforms when tested according to IEEE C62.45.

D. Comply with NFPA 70.

E. All SPDs provided within this project at the service entrance, distribution panels, and sub-panels shall be from the same manufacturer.

1.6 PROJECT CONDITIONS

A. Service Conditions: Rate SPDs for continuous operation under the following conditions unless otherwise indicated:
   1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
   2. Operating Temperature: 30 to 150 deg F.
   3. Humidity: 0 to 95 percent, non-condensing.
   4. Altitude: Less than 13,000 feet above sea level.

1.7 COORDINATION

A. Where field-mounted SPD's are specifically shown on plans, coordinate locations of field-mounted SPDs to allow adequate clearances for maintenance.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replaceable Protection Modules: 1 of each size and type installed, where field-replaceable modular SPDs are provided.
2. Fuses: 1 of each size and type installed, where field-replaceable fuses are provided.

PART 2 PRODUCTS

2.1 SURGE PROTECTIVE DEVICES

A. Manufacturer:
1. Integral Devices: Surge Protective Devices shall be as manufactured by the distribution equipment manufacturer (Square D, etc.), or by Surge Suppression Inc. if all of the performance of this specification are met and all UL listing of the equipment manufacturer are met.
2. External Devices (where specifically specified on plans): Surge Protective Devices shall be as manufactured by the distribution equipment manufacturer (Square D, etc.) or Surge Suppression Inc.

B. Each Surge Protective Device shall:
1. Be internal to the associated distribution equipment (without violating any applicable UL listings) unless specifically shown otherwise on plans.
2. Be UL 1449 (Latest Edition) listed.
3. Have short-circuit current rating complying with UL 1449 (Latest Edition), that matches or exceeds the short-circuit rating of the associated distribution equipment.
4. Be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.
5. Have fuses, rated at 200-kA interrupting capacity.
6. Have a minimum UL 1449 Nominal Discharge Current (I_n) Rating of 20kA.
7. Be fabricated using bolted compression lugs.
8. Provide suppression for seven (7) modes of protection.
9. Have LED indicator lights for power and protection status of each phase.
10. Have audible alarm, with silencing switch, to indicate when protection has failed.
11. Have form-C contacts rated at 2 A and 24-V ac minimum, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with facility monitoring and control system if monitoring by that system is required by plans or other specifications.
12. Have six-digit transient-event counter, mounted to front of equipment door, set to totalize transient surges (externally mounted SPD's may have the transient – event counter monted on the visible face of the SPD).
13. Meet all UL 96A requirements (for Lightning Protection Systems) where the device is installed at a service entrance of the facility. At a minimum, these devices shall:
    a. Be marked as Type 1 or Type 2 SPDs with product Identity consisting of "Surge Protective Device" or "SPD", and identifying all ratings so required by UL96A and the 4 digit alpha numeric Control Number.
    b. Have a minimum UL 1449 Nominal Discharge Current (I_n) Rating of 20kA.
    c. Be UL listed and labeled with holographic label.

C. Peak Single-Impulse Surge Current Rating shall be meet the following minimums unless specifically shown otherwise on plans:

Application	**Per Phase**	**Per Mode**
Service Entrance Devices	240 kA	120 kA
Downstream Devices	160 kA	80 kA

D. The ANSI/UL 1449 voltage protection rating (VPR) in grounded wye circuits, the SPDs shall not exceed the following:

Modes	**208Y/120V**	**480Y/277V**	**600Y/347V**
L-N,L-G, N-G	800	1200	1500
L-L	1200	2000	2500

E. The ANSI /UL 1449 VPR for 240/120 V, 3-wire or 4-wire circuits with high leg shall not exceed the following:

Modes	**240/120V**
L-N,L-G, N-G	1200/800

2.2 ENCLOSURES

A. Where external units are specifically specified on plans, units not mounted within electrical distribution equipment (such as switchboards, MCC's, etc.) shall be provided in enclosures with NEMA enclosure ratings that match or exceed the NEMA enclosure ratings of the equipment from which the units are fed. For example, a unit fed from a NEMA 4X stainless steel panelboard shall also be mounted within a NEMA 4X stainless steel enclosure.

PART 3 EXECUTION

3.1 INSTALLATION

A. All SPD's shall be integrally-mounted within the associated distribution equipment unless specifically shown otherwise on plans.

B. Install SPDs at service entrance on load side, with ground lead bonded to service entrance ground.

C. Install SPDs downstream of the service entrance with conductors or buses between suppressor and points of attachment as short and straight as possible. The lead lengths between the TVSS unit and the equipment being protected shall not exceed fourteen (14) inches without approval from the engineer. Do not bond neutral and ground. Leads shall be as straight as possible with no sharp bends.

D. Where externally-mounted SPD's are specifically shown on plans, provide circuit breaker as directed by the SPD supplier as a dedicated disconnecting means for SPD unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

A. Ensure that interiors are free of foreign materials and dirt.

B. Check and test switches, pushbuttons, meters for proper operation.

C. Check and test indicating lights for proper operation and color.

D. Perform manufacturer's on site field test procedures.

3.3 STARTUP SERVICE

A. Do not perform insulation resistance (MEGGER) tests of the distribution wiring equipment with the SPDs installed. Disconnect all wires, including neutral, before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 SYSTEM WARRANTY

A. The SPD system manufacturer shall warranty the entire SPD system against defective materials and workmanship for a period of ten (10) years from the date of substantial completion. This warranty is in effect as long as the unit is installed in compliance with the manufacturer's installation, operation, and maintenance manual, UL Listing requirements, and any applicable national or local electrical codes.

B. Any SPD device which shows evidence of failure or incorrect operation, including damage as the result of lightning strikes, during the warranty period shall be replaced by the manufacturer at no charge to the owner. Warranty will provide for multiple exchanges of any inoperable devices at any time during the warranty period which starts at the date of substantial completion of the system to which the surge suppressor is installed.

C. The manufacturer is required to have a nationwide network of factory-authorized local service representatives for repair and service of this product. The manufacturer shall have a dedicated 1-800 telephone number for service problems and questions. This number shall be manned by a knowledgeable factory employee to ensure prompt response to any emergency situation that may arise.

END OF SECTION 16289

SECTION 16410

SAFETY SWITCHES AND FUSES

PART 1 GENERAL

1.1 DESCRIPTION

A. Safety Switches

B. Fuses

C. Branch Feeders

D. Feeders

PART 2 PRODUCTS

2.1 SAFETY SWITCHES

A. Safety switches shall be quick-make, quick-break, NEMA heavy duty type HD, fused or nonfused as shown. Switch blades shall be fully visible in the off position.

B. Safety switches shall be furnished with transparent internal barrier kits to prevent accidental contact with live parts. Barriers shall provide finger-safe protection when the switch door is open and shall allow use of test probes and removal of fuses without removing barrier.

C. Fused switches shall have provisions for class R, rejection type fuses.

2.2 FUSES (600V)

A. Fuses for all branch switches shall be Bussman Mfg. Co., Dual Element, Class “R” Fusetron.

B. Fuses for main switch/switches shall be Bussman Mfg. Co. Hi-Cap.

2.3 MANUFACTURER

A. Safety switches shall be as manufactured by Square 'D' or Cutler Hammer.

B. Fuses shall be as manufactured by Bussman Mfg. Co. or equal.

PART 3 EXECUTION

3.1 SAFETY SWITCHES

A. Safety switches shall be installed as shown on the plans and in accordance with N.E.C.

B. Locations shown for safety switches on plans are diagrammatical only. Exact locations shall be field coordinated by contractor as required to provide code-required clearances.

C. Switch enclosures shall be rated NEMA I indoors in dry locations and NEMA 4X stainless steel outdoors and in wet or process areas.

D. Adequate support shall be provided for mounting safety switches. Safety switches shall not be mounted to the associated equipment (unless the safety switch is furnished with the equipment).

3.2 FUSES

A. Fuses shall be sized as shown on drawings, unless a smaller size is required by the associated equipment supplier, in which case the contractor shall provide fuses sized as directed by the associated equipment supplier at no additional cost.

B. Provide not less than one spare set of fuses for each size used. Provide an additional spare set for each five sets of same size fuses used.

END OF SECTION 16410

SECTION 16415

AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.1 SCOPE

A. Provide complete factory assembled power transfer equipment with field programmable digital electronic controls designed for fully automatic operation and including: voltage sensors on all phases of both sources, power switch mechanism, permanently attached manual operation provisions, positive mechanical and electrical interlocking, and mechanically held contacts for both sources.

B. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for all the products provided. Technicians specifically trained to support the product shall service the transfer switches.

1.2 CODES AND STANDARDS

A. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
1. CSA 282, Emergency Electrical Power Supply for Buildings
2. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
3. NFPA99 – Essential Electrical Systems for Health Care Facilities
4. NFPA110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems.
5. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
6. NEMA ICS10-1993 – AC Automatic Transfer Switches.

B. The transfer switch assembly shall comply with the following standards:
1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
2. EN55011, Class B Radiated Emissions
3. EN55011, Class B Conducted Emissions
4. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity.
5. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
6. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
7. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity
8. IEC 1000-4-6 Conducted Field Immunity
9. IEC 1000-4-11 Voltage Dip Immunity.
10. IEEE 62.41, AC Voltage Surge Immunity.
11. IEEE 62.45, AC Voltage Surge.
12. UL1008 – Transfer Switches. Transfer switches shall be UL1008 (latest edition) listed. UL1008 transfer switches may be supplied in UL891 enclosures if necessary to meet the physical requirements of the project.

C. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.3 ACCEPTABLE MANUFACTURERS

A. Cummins/Onan

B. Caterpillar

C. Russelectric

D. ASCO

E. Eaton

PART 2 PRODUCTS

2.1 POWER TRANSFER SWITCH

A. Ratings

1. Refer to the project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, voltage and ampere ratings, enclosure type, and accessories.
2. Main contacts shall be rated for 600 Volts AC minimum.
3. Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C, relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000M).
4. Transfer switch equipment shall have withstand and closing ratings (WCR) in RMS symmetrical amperes equal to or greater than the required ratings shown on the drawings (at the specified voltage). The transfer switch shall be third party listed and labeled for use with the specific protective device(s) (both normal and emergency) installed in the application. All rating information including associated overcurrent devices shall be submitted with shop drawings. Where WCR is dependent on setting of upstream overcurrent device, transfer switch shall be field marked with the required settings of the associated device. When a power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. The transfer switch and its upstream protection shall be coordinated.

B. Construction

1. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the source 1 and source 2 positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position.
2. Transfer switches shall be of the Programmed (Delayed) Transition type. Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms. Transfer switches over 1000 amperes shall be equipped with manual operators for service use only under de-energized conditions.

3. The switch shall completely disconnect the load from both sources for an adjustable period of time to allow regenerative voltage to decay to a safe level prior to connecting to the new source.
4. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
5. All wiring shall be UL listed 105 degree C, 600 volt rated, and sized as required. Each wire, device or function shall be identified with a source and destination by silk-screen or similar permanent identification. Circuit boards shall be connected wiring harnesses by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.
6. Bus structures shall be constructed from silver plated copper or tin plated aluminum with bolted joints for all three phases, with a full neutral, and a 1/4 x 2 inch ground bus extending through all sections.
7. The framework and all other sheet metal components of the system shall be primed with a rust-inhibiting primer, and finished with two coats of satin finish ANSI 61 gray enamel, or manufacturer's standard color.
8. All door mounted control components shall be industrial type oil-tight devices with contact ratings a minimum of twice the maximum circuit ampacity they are controlling. Toggle switches and other light duty and durability control devices are not acceptable. Indicator lamps shall be high intensity LED type devices. Indicator lamp condition (on or off) shall be easily visible in bright room lighting conditions.
9. Power transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation or shall be indicated by mechanical flags. Barriers shall be provided to prevent inadvertent contact with any voltage of greater than 50VDC.
10. Transfer switches shall be 4-pole with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Equipment using overlapping neutral contacts is not acceptable.

C. Connections
1. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
2. Transfer switch shall be provided with AL/CU compression lugs suitable for the quantities and sizes of power conductors required.

2.2 TRANSFER SWITCH CONTROL

A. Operator 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 permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities.
1. 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.
2. 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.

3. "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.
4. "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.
5. "RESET/LAMP TEST" pushbutton that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.
6. 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 an operator display panel.
7. Vacuum fluorescent alphanumeric display panel with push-button 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:
    a. Display source condition information, including AC voltage for each phase of normal and emergency source, frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance. Line to neutral voltages shall be displayed for 4-wire systems.
    b. Display source status, to indicate source is connected or not connected.
    c. The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:
        1) Set nominal voltage and frequency for the transfer switch.
        2) Adjust voltage and frequency sensor operation set points.
        3) Set up time clock functions.
        4) Set up load sequence functions.
        5) Enable or disable control functions in the transfer switch, including program transition.
        6) 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.
    d. Display Real time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall be incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
    e. 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.
    f. 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.

B. Internal Controls

1. 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 plus or minus 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.
2. Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:
    a. 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).
    b. 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).
    c. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for voltage imbalance.
    d. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for loss of a single phase.
    e. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for phase rotation.
    f. 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).
    g. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for over or under frequency conditions.
3. The transfer control shall incorporate a series of diagnostic LED lamps.
4. 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. The program/delayed transition time setting (time in which load is not connected to either source during transfer) shall be initially set at 10 seconds to allow motors to properly decay per MG-1 standard
5. The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop (cooldown) (adjustable in a range of 0-30 minutes).
6. The transfer switch shall be configurable to accept a relay contact signal from an external device to prevent transfer to the generator service.
7. 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 surge and RFI/EMI standards.
8. 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.

C. Control Interface

1. The transfer switch shall provide an isolated relay contact for starting of 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.
2. The integrity of the generator remote start circuit shall be monitored for broken, disconnected or shorted wires. Loss of integrity shall start the generator.
3. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.
4. The transfer switch shall provide additional relay contacts to indicate the following conditions: Utility Source Available, Load Connected to Utility, Generator Source Available, Load Connected to Generator, Pre-Transfer Warning (adjustable 0-59 second time delay).

2.3 ENCLOSURE

A. Enclosures shall be UL listed. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70. The cabinet door shall include permanently mounted key type latches.

B. If not specifically indicated otherwise on plans, transfer switch equipment enclosures shall meet the following minimum requirements:

1. For dry interior locations: NEMA 1 or better (unless shown otherwise on plans).
2. For wet interior (pump stations, etc.) or exterior locations: NEMA 4X 304 Stainless Steel or better (unless shown otherwise on plans).

C. The cabinet shall provide code-required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles and/or non key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

D. Note size and access requirements for the transfer switch (and associated equipment) and provide equipment that will fit into the space allowed and comply with code-specified access requirements.

2.4 SERVICE ENTRANCE RATED MAIN UTILITY BREAKERS:

A. Where specifically required or so shown on plans (this is not required for all ATSs), the ATS shall be provided with a service entrance rating, complete with an integral main utility breaker as specified (with through-door handle and labeling per specification requirements), and neutral-ground bonding per NEC requirements.

2.5 MANUAL BYPASS-ISOLATION SWITCH

A. Transfer switches shall include (integral to the transfer switch assembly) transfer switch bypass and isolation equipment as described in this section. The bypass-isolation switch shall provide a means for manually bypassing the transfer switch from either source (Normal or Emergency) to the load, while under load if necessary, and to isolate the transfer switch from both sources for maintenance or repair. Designs that bypass to only one source are not acceptable under this specification.

B. Bypass-isolation switch equipment shall be UL Listed per Standard 1008, CSA Approved; with continuous current rating, voltage and frequency ratings, and withstand and closing ratings equal to the transfer switch ratings at the specified conditions of ambient temperature, humidity, and altitude.

C. The bypass-isolation and transfer switches shall be mechanically held in each position. Switching mechanisms shall be break before make on all poles, including the neutral pole on four pole switches. The switch mechanism shall be an over center toggle device which provides stored energy contact operation during both opening and closing. The speed of contact operation shall be independent of the force applied to the operating handles, which permit manual operation under load.

D. Bypass switch shall be a fully rated manually operated switch, rated for the same loads as the automatic transfer switch. Bypass switch shall provide bypass to either normal or emergency source by use of a door-mounted keyed source selector switch and a permanently mounted external-operating handle. Equipment shall provide manual bypass without disturbance of the power supply to the load. Equipment requiring load isolation before bypass is not acceptable for use on this project.

E. Equipment shall provide for manual bypass operation to the source opposite that to which the transfer switch is connected. This shall cause the transfer switch to go automatically to a position disconnected from both sources. Equipment that does not provide a rapid means of opposite source bypass is not acceptable under this specification.

F. Positive mechanical interlocks shall prevent all possible source to source interconnections. Designs which depend on electrical interlocks to prevent source to source interconnections, or which intentionally interconnect the sources, are not acceptable. The interlock system shall assure a properly sequenced, mechanically guided bypass and isolation action.

G. The equipment shall utilize automatic, solenoid-activated mechanical stops to prevent manually bypassing to a dead source. Equipment that does not prevent dead source bypass is not acceptable.

H. A drawout isolation mechanism shall provide closed-door isolation of the transfer switch, using a permanently mounted, external handle. The isolation mechanism shall be interlocked so that either the transfer switch must be bypassed or the transfer switch must be open, before the mechanism will permit isolation of the transfer switch.

I. The isolation mechanism shall provide for three-position operation; Connected, Test, and Isolated. In the Connected position, isolation contacts shall be fully engaged and closed, with the transfer switch control cable connected. In the Test position, isolation contacts shall be open and the transfer switch control cable connected. The Test position shall allow operational testing of transfer switch and controls without power disruption to the load. In the Isolated position, the transfer switch and control shall be completely isolated from all power sources. In the isolated position, safety shutters shall close to cover bypass switch power terminals minimizing the possibility of accidental contact with energized parts. In the isolated position, the transfer switch shall be capable of being withdrawn from the cabinet, and removed using overhead lifting equipment. Mechanisms that do not allow for drawout and removal for servicing using overhead lifting equipment are not acceptable under this specification. When re-installing the

transfer switch, from isolated to connected position, the isolation mechanism shall not permit connection of the transfer switch unless it is in the open position, and shall automatically open the transfer switch if necessary regardless of the availability of electrical power. When the transfer switch is fully connected and locked in place, the mechanism shall move the transfer switch from the open position to the closed position on the same source as the bypass switch.

J. The bypass and isolation process for the automatic transfer switch shall be capable of being fully accomplished without opening the cabinet door.

2.6 BATTERY CHARGING

A. The transfer switch/generator set combination shall be provided with a battery charger for the generator set starting batteries. Refer to Generator Sets Specification Section 16231 for specific requirements. Supply power failed indication shall be displayed on the ATS control panel.

2.7 SEQUENCE OF OPERATION

A. Programmed (Delayed) Transition Sequence of Operation
   1. Normal State:
      a. Transfer switch normally connects an energized utility power source (source 1) to loads and a generator set (source 2) to the loads when normal source fails. The normal position of the transfer switch is connected to source 1 (connected to the utility), and no start signal is supplied to the genset.
   2. Normal Power Failure and Restoration:
      a. When the transfer switch senses a power failure on source 1, it shall complete a pre-programmed time delay start sequence, and then send a start signal to the generator set.
      b. The generator set shall immediately start and accelerate to rated voltage and frequency.
      c. The transfer system shall complete a programmable time delay sequence, and then transfer to source 2 by delayed (programmed) transition. The transfer switch shall accomplish this by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later (to allow motor loads to decay per NEMA MG-1 standard).
      d. On return of source 1 to acceptable voltage and frequency levels, the control system shall initiate a time delay retransfer sequence. On completion of the time delay sequence, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later (to allow motor loads to decay per NEMA MG-1 standard). The timing sequence for the contact operation shall be programmable in the controller. The control system shall transfer loads back to source 1 in the reverse sequence to that which was used to connect loads to source 2.
      e. If the generator set fails during this period and normal source is available, the transfer switch shall automatically reconnect the system loads to the normal service.
      f. The transfer switch shall operate the generator set unloaded for a cooldown period, and then remove the start signal from the generator set.

3. Generator Set Exercise (Test) With Load Mode (Delayed (programmed)Transition). The control system shall be configurable to test the generator set under load. In this mode, the transfer switch shall control the generator set in the following sequence:
   a. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
   b. The transfer switch shall issue a compatible start command to the generator set as follows:
      1) On generators rated 50kW and greater, the transfer switch shall cause the generator set to start and run at idle until it has reached normal operating temperature. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.
      2) On generators rated less than 50kW, the generator set shall immediately start and accelerate to rated voltage and frequency.
   c. When the control systems senses the generator set at rated voltage and frequency, it shall operate to connect the loads to the generator set by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later (to allow motor loads to decay per NEMA MG-1 standard). The timing sequence for the contact operation shall be programmable in the controller.
   d. The generator set shall operate connected to the load for the duration of the exercise period.
   e. On completion of the exercise period, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later (to allow motor loads to decay per NEMA MG-1 standard). The timing sequence for the contact operation shall be programmable in the controller.
   f. The transfer switch shall operate the generator set unloaded for a cooldown period, and then remove the start signal from the generator set.
   g. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.
   h. If the generator set fails during the exercise period and normal source is available, the transfer switch shall automatically reconnect the system loads to the normal service.
4. Generator Set Exercise (Test) Without Load Mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode, the transfer switch shall control the generator set in the following sequence:
   a. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
   b. The transfer switch shall issue a compatible start command to the generator set as follows:
      1) On generators rated 50kW and greater, the transfer switch shall cause the generator set to start and run at idle until it has reached normal operating temperature. When the generator set has reached normal operating temperature or after an adjustable time period (whichever

is shorter), the control system shall accelerate the generator set to rated voltage and frequency.

2) On generators rated less than 50kW, the generator set shall immediately start and accelerate to rated voltage and frequency.

c. When the control systems senses the generator set at rated voltage and frequency, it shall operate the generator set unloaded for the duration of the exercise period.

d. At the completion of the exercise period, the transfer switch shall remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

PART 3 EXECUTION

3.1 POWER COMPANY APPROVAL

A. The transfer switch shall be designed to meet all applicable power company requirements for connection to the power company's system, and if applicable, shall be on the power company's approved list of automatic transfer switches. Contractor shall ensure that transfer switch is specifically approved by power company for connection to their system prior to purchasing the transfer switch.

3.2 FACTORY TESTING

A. The transfer switch manufacturer shall perform a complete operational test on the transfer switch prior to shipping from the factory. A certified test report shall be submitted. Test process shall include calibration of voltage sensors.

3.3 SERVICE AND SUPPORT

A. The manufacturer of the transfer switch shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

B. The transfer switch shall be serviced by a local service organization that is trained and factory certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

C. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.

D. After generator set installation, the generator set supplier shall conduct a complete operation, basic maintenance, and emergency service seminar for up to 5 persons employed by the facility owner. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the PC based service and maintenance tools provided under this contract, and emergency operation procedures. The class duration shall be at least 4 hours in length, and include practical operation with the installed equipment.

3.4 WARRANTY

A. The automatic transfer equipment shall be warranted (by the generator supplier when a generator is supplied within the project) for a period of not less than 2 years from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

END OF SECTION 16415

SECTION 16440

SWITCHBOARDS

PART 1 GENERAL

1.1 SCOPE

A. This section deals with requirements for circuit breaker type switchboards.

PART 2 PRODUCTS

2.1 SWITCHBOARDS

A. General:

1. Switchboard shall be totally enclosed, self supporting metal structure, contain industrial type main and distribution molded case circuit breakers and other associated equipment as indicated. The switchboard shall be completely front accessible.
2. Each switchboard, as a complete unit, shall be given a single integrated equipment rating by the manufacturer. The integrated equipment short circuit rating shall certify that all equipment is capable of withstanding the stresses of a fault equal to that of the least over current protective device contained therein. Such rating shall be established by the actual tests by the manufacturer on a similar equipment construction as the subject switchboard. This test data shall be available and shall be furnished to the engineer, if requested, with or before the submittal or approved drawing. Entire switchboard assembly, including all bussing, shall have SCCR ratings meeting or exceeding the minimum AIC ratings listed on the plans for the switchboard. When a power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. All ratings shall be full ratings. Series ratings will not be allowed unless shown otherwise on drawings.
3. Main lugs shall be provided with AL/CU compression lugs suitable for the quantities and sizes of conductors required.
4. Future Provisions: All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
5. Top/bottom feed arrangement and lug sizes/quantities shall be coordinated by the contractor.

B. Bussing:

1. The switchboard bussing shall be silver plated copper and of sufficient cross-sectional area to continuously conduct rated full load current as shown on plans with a maximum temperature rise of 50 degrees C., above an ambient temperature of 25 degrees C. Switchboard shall have a 25% full length ground bus. Neutral bus shall be full capacity. Connections for all current carrying parts shall be bolted. Aluminum bussing is not acceptable. Tapered bussing is not acceptable.

2. The main horizontal bus shall be located at the back of the switchboard to permit a maximum of available conduit area. The end section shall have bus provisions for future addition. The provisions shall include the bus installed to the extreme side of the switchboard and pre-punched to facilitate future bolted splice plates. The horizontal main bus supports, connections, and joints shall be bolted with grade 5 carriage bolts and Belleville washers. The main horizontal bus shall be same size, continuous through the board.

2.2 CIRCUIT BREAKERS

A. Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated (or can be adjusted to is 1200A or higher, breakers shall be electronic trip and shall be provided with arc energy-reducing maintenance switching (with local status indicator) to reduce arc flash energy per NEC 240.87 requirements.

B. Circuit breakers shall be quick-break, quick-make thermal-magnetic type for alternating current unless noted otherwise. Breakers shall trip free of the handle and tripping shall be indicated by the handle assuming a position between OFF and ON. Multipole breakers shall be internal common trip with single operating handle; external handle ties are not acceptable.

C. All breakers shall meet the minimum RMS symmetrical interrupting capacity ratings shown on plans for the associated panel. All interrupting ratings shall be full ratings. Series ratings will not be allowed unless shown otherwise on drawings.

D. Main circuit breakers, 1000 amps and larger, on 277/480 volt, 3 phase, 4 wire systems shall be electronic trip molded case 80% rated equipped with ground fault sensing and automatic trip unless noted otherwise. The following requirements shall be met:
1. These main breakers shall be equipped with an electric trip device having the following fully-adjustable, time/current response adjustments:
   a. Long Time Pickup.
   b. Long Time Delay.
   c. Short Time Pickup.
   d. Short Time Delay
   e. Ground Fault Pickup.
   f. Ground Fault Delay.
   g. Instantaneous settings.

E. All circuit breakers shall be installed so that the center of the grip of the operating handle, when in its highest position, is not more than 6’-7” above the floor or working platform (the height of the concrete housekeeping pad shall be included in the breaker height calculations).

F. All branch circuit breakers shall be listed to UL489 or shall be specially-tested to be HACR listed.

2.3 SWITCHBOARD FRAMING & CONSTRUCTION

A. The switchboard shall be fabricated on a die-form steel base assembly consisting of formed steel and commercial channel welded or bolted together to rigidly support the entire shipping unit for moving on rollers and floor mounting. The framework is to be

formed code gauge steel, rigidly welded and bolted together to support all cover plates, bussing, and component devices during service and installation. The dimensions shall be shown on plans. These dimensions shall not be exceeded without specific approval.

B. Each switchboard section shall have one open bottom and individual removable top plate for installation and termination of conduit. Top and bottom conduit area is to be clearly shown and dimensioned on the shop drawings. The wireway front covers are to be hinged to permit access to the branch circuit breaker load side terminals without removing the covers. All front plates used for mounting meters, selector switches or other front mounted devices shall be hinged with all wiring installed and laced with flexibility at the hinged side. All course plates shall be screw removable and small enough for easy handling by one man. The paint finish shall be gray enamel over a rust-inhibiting phosphate primer, ASA #48.

2.4 ACCESSORIES

A. Each circuit breaker shall have engraved black on white engraved nameplate, providing circuit identification.

B. Provide power meter (with door-mounted display) to monitor, display and alarm relevant current, voltage, power and energy variables. Shall be Square ‘D’ #PM850 or equal.

2.5 MANUFACTURER

A. Switchboard to be manufactured by Square 'D' or Cutler Hammer or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Switchboards shall be installed on four inch thick concrete pads unless specifically shown otherwise. Pad shall extend a minimum of 4 inches to all sides of the switchboard and shall have beveled edges.

B. All switchboard dimensions and clearances shall be carefully checked and coordinated with the proper trades to ensure proper mounting space and support prior to roughing in equipment.

C. Wiring in panelboard gutters shall be done in a neat and workmanlike manner. Wiring shall be grouped into neat bundles and secured with approved tie wraps.

3.2 SWITCHBOARD IDENTIFICATION

A. Refer to Specification Section 16075.

END OF SECTION 16440

SECTION 16442

LIGHTING PANELBOARDS

PART 1 GENERAL

1.1 GENERAL

A. The work under this section includes but is not limited to the following:
   1. Lighting Panelboards
   2. Circuit Breakers

PART 2 PRODUCT

2.1 PANELBOARDS

A. Enclosure:
   1. Panelboards shall be dead front type and shall be in accordance with Underwriter's Laboratories, Inc., standard of panelboards and enclosing cabinets and so labeled.
   2. Panelboards installed in dry locations shall have enclosures fabricated from sheet steel and shall be finished in ASA #49. Panelboards installed in corrosive, exterior or wet locations shall have NEMA 4X stainless steel enclosures.
   3. The door shall have a cylinder type lock. Lock shall be held in place by concealed screw to a captive nut, welded to inside of door. All locks shall be keyed alike.
   4. A metal framed circuit directory card holder with clear plastic covering shall be factory-mounted on the inside of door.
   5. Panels for 20 or more circuits, including spares and spaces, shall be 20 inches wide.
   6. Panelboards enclosures shall be as shown on panel schedule on plans for surface, flush or motor control center mounting.
   7. Provide hinged trim with piano-hinge down full length of one side to allow access to wiring without complete removal of outer trim.
   8. Each section of multi-section panelboards shall be of matching heights and depths.

B. Bussing/Lugs:
   1. Ampacity and service voltage of main buss, lugs or main breakers and branch circuit breakers shall be as shown on drawings.
   2. All bussing and associated connectors shall be tin-plated copper.
   3. All panelboards shall contain ground buss.
   4. Entire panelboard shall be capable of withstanding a short circuit not less than the interrupting capacity of any breaker in the panel. When a power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. Interrupting ratings shall be full ratings. Series ratings will not be allowed unless shown otherwise on drawings.
   5. Buss connectors shall be for distributed phase arrangement.

6. Main and sub-feed lugs shall be provided with AL/CU compression lugs suitable for the quantities and sizes of conductors required.
7. Top/bottom feed arrangement and lug sizes/quantities shall be coordinated by the contractor.
8. Entire panelboard assembly, including all bussing, shall have SCCR ratings meeting or exceeding the minimum AIC ratings listed on the plans for the panel. When a power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. All ratings shall be full ratings. Series ratings will not be allowed unless shown otherwise on drawings.
9. Service entrance panelboards shall be provided with barrier such that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations

C. Breaker arrangement and numbering:
1. Panelboards shall be factory assembled with branch breakers arranged exactly as indicated on plans.
2. Breakers shall be numbered vertically beginning top left. Multi-section panelboards shall be numbered consecutively through all sections.
3. Breaker numbers shall be permanently attached to trim.
4. Main breakers shall be vertically-mounted (branch-mounted or back-fed main breakers will not be acceptable unless specifically so shown on plans).

2.2 CIRCUIT BREAKERS

A. Circuit breakers shall be quick break, quick make, thermal magnetic type, for alternating current. Breakers shall trip free for the handle and tripping shall be indicated by the handle assuming a position between OFF and ON.

B. Circuit breakers shall be of the bolt-on type.

C. Multi-pole breakers shall be internal common trip with single operating handle; external handle ties are not acceptable, unless specifically noted otherwise (such as for multi-wire branch circuits described below).

D. Circuit breakers feeding multiwire branch circuits (as defined by NEC) consisting of separate single phase loads sharing a common neutral shall be provided with multi-pole breakers or handle ties to simultaneously disconnect all ungrounded conductors per NEC Article 210.4(B). The necessary locations of these multi-pole breakers or handle ties shall be coordinated by the contractor. Where necessary, the contractor may rearrange circuit breakers (as minimally as possible) as required to meet this requirement.

E. All breakers shall meet the minimum RMS symmetrical interrupting capacity ratings shown on plans for the associated panel. All interrupting ratings shall be full ratings. Series ratings will not be allowed unless shown otherwise on drawings.

F. All branch circuit breakers shall be listed to UL489 or shall be specially-tested to be HACR listed.

2.3 SPECIAL REQUIREMENTS

A. Any special requirements on the drawings, such as for increased interrupting rating, ground fault protection, etc., shall supersede these specifications, but only insofar as that particular requirement is concerned.

B. Lighting panels larger than 400A shall conform to the requirements for power panels.

2.4 MANUFACTURER

A. Panelboards shall be as manufactured by Square 'D' or Cutler Hammer.

PART 3 EXECUTION

3.1 INSTALLATION

A. All panelboard dimensions and clearances shall be carefully checked and coordinated with the proper trades to ensure proper mounting space and support prior to roughing in equipment. In no case shall any circuit breaker be located above 6'-7" A.F.F..

B. Wiring in panelboard wireways shall be done in a neat and workmanlike manner. Wiring shall be grouped into neat bundles and secured with approved tie wraps.

C. For all flush-mounted panelboards, a minimum of three (3) one-inch empty conduits shall be stubbed out above the nearest accessible ceiling space for future use.

3.2 PANEL IDENTIFICATION

A. Refer to Specification Section 16075.

END OF SECTION 16442

SECTION 16480

MANUFACTURED CONTROL PANELS

PART 1 GENERAL

1.1 SCOPE

A. This section describes control stations, PLC panels, motor control panels, manufactured control panels, and other similar panels specified herein. Specifications herein are intended as an extension of requirements in other Divisions of these specifications where reference is made to Electrical Specifications.

1.2 DEFINITIONS

A. "Control Stations": Enclosures (with all required accessories) containing only door-mounted pushbuttons, indicator lights and/or selector switches (no electronic components or starter/controller equipment).

B. "Control Panels": Enclosures (with all required accessories) containing equipment/devices other than door-mounted pushbuttons, indicator lights and/or selector switches (such as electronic components, starter/controller equipment, etc.).

1.3 SUBMITTALS

A. Provide the following for each control panel:
   1. A job-specific, custom wiring diagram
      a. The wiring diagram shall clearly show all components (whether the components are mounted internal or external to the control panel enclosure).
      b. All wires and terminal blocks shall be clearly labeled.
      c. Diagram shall be in accordance with NEMA/ICS standards.
   2. Size, type and rating of all system components.
   3. Unit frontal elevation and dimension drawings.
   4. Internal component layout diagrams.
   5. Manufacturer's product data sheets for all components.

B. A Bill of Materials shall be included with catalog information on all components.

C. Information shall be included on any proprietary logic component sufficient to demonstrate its ability to perform the required functions.

D. The following calculations shall be submitted:
   1. Thermal calculations showing amount of panel cooling/ventilating/heating required for each control panel, per ambient requirements listed below and operating temperature limitations of all equipment/devices within each control panel. See Part 2 below for requirements for forced air ventilation rather than air conditioning. Panel shall be oversized, interior equipment/devices shall be derated, and solar shielding shall be provided as required to allow the use of forced air ventilation as the cooling method. Air conditioning, ventilation, and/or heating equipment shall each have ratings/capacities at least 20% larger than required by calculations below unless noted otherwise:

a. Thermal calculations used for sizing cooling/ventilation systems for each control panel located in exterior or non-conditioned spaces shall assume:
   1) Ambient exterior air temperature ranges of -5 degrees F to 105 degrees F.
   2) Full solar contact where applicable (not applicable where enclosures are fully protected from solar contact using solar shields separated from panel enclosure with standoffs or similar).
   3) No wind.
   4) Heat loss from interior equipment (electronics, etc.) per equipment supplier's information.

b. Thermal calculations used for sizing heating systems for each control panel shall assume:
   1) Ambient exterior air temperature ranges of -5 degrees F to 105 degrees F.
   2) No heat loss by interior components of control panel.
   3) No solar gain on exterior of control panel.
   4) Doubling of heating wattage required to account for wind where control panels are located outdoors.
   5) Minimum temperature difference (due to heating) of 10 degrees F to prevent condensation, regardless of equipment temperature limitations.

2. Load calculations showing the sizing of all power supplies provided (with spare capacity as specified). Power supplies shall each have ratings/capacities at least 20% larger than required by load calculations unless noted otherwise.
3. Load calculations showing the sizing and anticipated runtime of all Uninterruptible Power Supply systems provided (with spare capacity as specified).

PART 2 PRODUCTS

2.1 GENERAL

A. Control panels shall be Underwriters' Laboratories labeled by the panel manufacturer. Control panel manufacturers not capable of applying the U.L. label to their products are unacceptable.

B. All human interface equipment/devices (indicator lights, selector switches, pushbuttons, time switches, displays, keypads, and other similar items used for control, adjustments or monitoring) shall be mounted on the non-energized side of enclosure door(s) in such a way as to be accessible without exposing the user to energized parts.

C. All

2.2 RATINGS

A. All Control Panels shall have short circuit current ratings at least equal to the lesser of the following, unless noted otherwise on plans:
   1. The short circuit current rating of the electrical distribution equipment that feeds the Control Panel.
   2. 150% of the available fault current at the Control Panel as determined by a Short Circuit Current study prepared by a licensed professional electrical engineer.

B. All equipment/devices installed within control panels shall be rated to operate in ambient temperatures of 50 degrees C (122 degrees F) or higher.

2.3 ENCLOSURES

A. All enclosures (with any required accessories or auxiliary items) shall fit within the space shown on the Plans. Any costs associated with furnishing equipment which exceeds the available space shall be borne by the Contractor.

B. Enclosures (with any required accessories or auxiliary items) shall be suitable for the environment where installed.

C. Enclosure materials shall be as follows unless noted otherwise:
   1. Control Stations:
      a. Where located in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.): NEMA 4X of non-metallic construction (with non-metallic hardware) compatible with the associated chemical(s).
      b. Where located in other wet, process or outdoor areas: NEMA 4X of type 304 stainless steel construction (with stainless steel hardware).
      c. Where located in dry, non-process, indoor areas (such as electrical rooms): NEMA 1 of die cast zinc/aluminum construction.
   2. Control Panels:
      a. Where located in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.): NEMA 4X of non-metallic construction (with non-metallic hardware) compatible with the associated chemical(s).
      b. Where located in other wet, process or outdoor areas: NEMA 4X of type 304 stainless steel construction (with stainless steel hardware).
      c. Where located in dry, non-process, indoor areas (such as electrical rooms): NEMA 1 or 12.

D. Control Panel Enclosure Construction:
   1. Non-metallic control panel enclosure material, where specified, shall be reinforced polyester resin or equivalent, with a minimum thickness of 3/16 inch for all surfaces except those requiring reinforcement. Panels shall be precision molded to form a one piece unit with all corners rounded. Exterior surfaces shall be gel-coated to provide a corrosion-resistant maintenance-free satin finish which shall never need painting. Color pigments shall be molded into the resin. Color shall be grey.
   2. Metallic control panel enclosures, where specified, shall be fabricated using a minimum of 14 gauge steel for wall or frame mounted enclosures and a minimum of 12 gauge for freestanding enclosures. Continuously weld all exterior seams and grind smooth. Reinforce sheet steel with steel angles where necessary support equipment and ensure rigidity and preclude resonant vibrations.
   3. Use pan-type construction for doors.
   4. Door widths shall not exceed 36-inches.
   5. Mount doors with full length, heavy duty piano hinge with hinge pins.
   6. Provide gasket completely around each door opening.
   7. Mount and secure all internal components to removable back plate assembly.
   8. For NEMA 1 or 12 enclosures, provide handle-operated key-lockable three point stainless steel latching system for each door.

9. For NEMA 4X enclosures, provide provisions for padlocking all doors and provide clamps on three (3) sides of each door.

E. Control panel enclosures (and associated backpanels and other similar accessories) shall be manufactured by Hoffman Engineering Co., or Saginaw Control & Engineering.

2.4 CONTROL PANEL ACCESSORIES:

A. Panel ventilation systems shall be provided if so required by the application to maintain temperatures within the acceptable ranges of the interior equipment. In no case (regardless of temperature ratings of internal equipment) shall maximum temperatures within control panels be allowed to exceed 50 degrees C (122 degrees F). Panel Air Conditioners or Heat Exchangers (to satisfy the specified thermal calculation requirements) are generally NOT acceptable unless specifically stated otherwise in these specifications, and shall not be provided for panels without specific written direction from the engineer PRIOR to submission of panel shop drawings. Panels shall be oversized, provided with standoffs/shields, and/or ventilated as required to meet the contract requirements. Thermostats shall be provided to control cooling without need of manual operation. Thermostat setpoints shall be as per recommendations of the equipment suppliers. See above for thermal calculation requirements. Cooling units shall be as manufactured by Hoffman Engineering Co., Rittal or approved equal and shall be thermostatically controlled.

B. Space heaters shall be provided for condensation and temperature control. Thermostats AND hygrostats (or combination hygrotherm controllers) shall be provided to control heating requirements (based on temperature and relative humidity within enclosure) without need of manual operation. Setpoints shall be as per recommendations of the equipment suppliers. See above for thermal calculation requirements. Space heaters and associated control devices shall be as manufactured by Hoffman Engineering Co., Rittal, Stego or approved equal.

C. NEMA 4X control panels shall be provided with vapor-phase corrosion inhibitor(s) (chemical combinations that vaporize and condense on all surfaces in the enclosed area, to protect metal surfaces/devices within the enclosed area from corrosion). Corrosion inhibitor shall be Hoffman #AHCI series (sized as required by the enclosure volume to be protected) or equal.

D. For outdoor panels, stainless steel solar shields for front, top and each side of panel, supported to associated panel face with standoffs as required (to allow free air flow between solar shield and panel enclosure), shall be provided where required to limit solar loading on panel to allow use of a ventilated panel design rather than an air-conditioned panel design.

E. Provide a sun shield over all LCD displays in exterior-mounted panels. Sun shield shall be collapsible to fully protect LCD display from UV light when not in use, shall provide side and top shielding when in use, shall be constructed of stainless steel and shall be installed such as to maintain NEMA 4X ratings of enclosures.

F. Provide a clear polycarbonate gasketted hinged door or window to encompass all indicators, controllers, recorders, etc. mounted on NEMA 4 and 4X enclosures.

G. Provide interior mounting panels and shelves constructed of minimum 12 gauge steel with white enamel finish. Provide metal print pocket with white enamel finish on inside of door.

H. Provide interior LED light kit, mounted at top of interior of panel, and switched to turn "ON" when door is opened for the following control panels:
   1. Control panels with outer dimensions greater than 20" wide or 30" high.
   2. Control panels containing PLCs or other similar programmable devices.

I. Control panels containing VFDs or Reduced Voltage Soft Starters shall include a door mounted digital keypad for adjusting the starter parameters and viewing process values and viewing the motor and starter statuses without opening the enclosure deadfront door.

2.5 CONTROL COMPONENTS

A. General:
   1. All pushbuttons, pilot lights, selector switches and other control devices shall be separate, standard size (full 30mm) and shape, heavy duty oil-tight units.
      a. Devices in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.) shall be of non-metallic construction.
      b. Devices in other areas shall be of chrome-plated construction.
   2. All components and devices so that connection can be easily made and so there is ample room for servicing each item.
   3. Door-mounted indicators, recorders, totalizers and controllers shall be located between 48" and 72" above finished floor level.
   4. Door-mounted indicator lights, selector switches and pushbuttons shall be located between 36" and 80" above finished floor level.
   5. All devices and components shall be adequately supported to prevent movement. Mounting strips shall be used to mount relays, timers and other devices suitable for this type of mounting.

B. Pilot Lights:
   1. All pilot lights to be cluster LED type & push to test.

C. Pushbuttons:
   1. All STOP operators within control stations located at equipment shall be provided with lockout provisions and a minimum of two (2) sets of contact blocks.
   2. Emergency shutoff pushbutton devices shall be as follows unless noted otherwise:
      a. 2 ¼" diameter, mushroom-style, maintained contact push buttons
      b. With a minimum of one (1) normally open dry contact and three normally closed dry contacts.
      c. Connections made such that pushing "in" the button will shutoff the associated equipment.
      d. Provided with a red engraved nameplate with ½" lettering to read "Emergency Shutoff".

D. Relays:
   1. Control relays shall have the following characteristics, unless noted otherwise:
      a. General purpose, plug-in type.

b. Minimum mechanical life of 10 million operations.
c. Coil voltage as indicated or required by application.
d. Single-break contacts rated 12 amperes, resistive at 240 volts.
e. Contacts as shown on wiring diagrams plus a minimum of one (1) spare N.O. contact and one (1) spare N.C. contact. At a minimum, each individual relay shall have 3PDT contacts. Where required, multiple control relays shall be provided (to provide the required quantities of contacts) for each "relay" function shown on plans/diagrams.
f. Furnished with RC transient suppressor to suppress coil-generated transients to 200% of peak voltage.
g. LED on/off indicator light and manual operator.
h. Industry standard wiring and pin terminal arrangements.
i. Equal to Square D 8501KP series with matching plug-in socket.

2. Interposing/isolation relays used to isolate discrete output field wiring (and where required for voltage translation for other discrete signals) to/from PLC inputs/outputs shall be terminal-block style. Terminal-block style relays shall have the following characteristics, unless noted otherwise:
   a. Minimum mechanical life of 10 million operations.
   b. Single-break contacts rated 6 amperes, resistive at 120 volts.
   c. One (1) N.O. contact per relay.
   d. Furnished with integral transient protection.
   e. LED on/off indicator light.
   f. DIN-rail mounted.
   g. Equal to Square D type Zelio RSL.
3. Timer relays shall be electronic, adjustable plug-in devices meeting the following characteristics, unless noted otherwise:
   a. General purpose, plug-in type.
   b. Minimum mechanical life of 10 million operations.
   c. Single-break contacts rated 10 amperes, resistive at 240 volts.
   d. Contacts as shown on wiring diagrams plus a minimum of one (1) spare N.O. contact and one (1) spare N.C. contact. At a minimum, each relay shall have DPDT contacts (2 N.O. & 2N.C.). Where required, multiple timer or control relays shall be provided (to provide the required quantities of contacts) for each "relay" function shown on plans/diagrams.
   e. Rotary-thumbwheel adjustments for time value, timing range and function.
   f. Time value adjustments from .05 seconds to 999 hours
   g. Selectable Timing Functions, including the following:
      1) On Delay
      2) Interval
      3) Off Delay
      4) One Shot
      5) Repeat Cycle-Off
      6) Repeat Cycle-On
      7) On/Off Delay
      8) One Shot Falling Edge
      9) Watchdog
      10) Trigger On Delay
   h. Accuracy shall be $\pm$ 2% and repeatability shall be $\pm$ 0.1%.
   i. Furnished with integral transient protection.

j. LED indicator light(s) for “timing” and “on/off status”
k. Held in place with hold-down spring
l. Equal to Square D type JCK with matching plug-in socket.

2.6 CONFORMAL COATINGS

A. All printed circuit boards within electronic devices (PLCs, RTUs, controllers, I/O modules, power supplies, touchscreens, Ethernet switches, radios, etc.) installed in panels located in non-conditioned or exterior/process areas shall be conformal-coated for harsh environments.

2.7 DC POWER SUPPLIES

A. DC Power supplies shall be provided where specified elsewhere, or as required by design of system. Power supplies shall be industrial type, AC-to-DC switching, output voltage as required, 120vac input, size as required for the initial application plus 50% spare capacity.

B. Redundant power supplies with diode isolation shall be provided so that the loss of one power supply does not affect system operation. The back-up supply systems shall be designed so that either the primary or the back-up supply can be removed, repaired, and returned to service without disrupting the system operation.

C. Power supply output shall be protected by secondary overcurrent protection device(s).

D. The power distribution from multiloop supplies shall be selectively fused so that a fault in one instrument loop will be isolated from the other loops being fed from the same supply.

E. Each power supply shall meet the following requirements.
1. Regulation, line: 0.4% for input from 105 to 132vac.
2. Regulation, load: 0.8%
3. Ripple/Noise: 15mV RMS / 200 mV peak to peak
4. Operating temperature range: 0 deg C - 60 deg C
5. Overvoltage protection
6. Overload Protection
7. Output shall remain within regulation limits for a least 16ms after loss of AC power at full load.
8. Output status indicator.
9. UL listing

F. Power supplies shall be manufactured by Puls, Sola, Phoenix Contact or equal.

2.8 UNINTERRUPTIBLE POWER SUPPLIES

A. Uninterruptible power supplies (UPSs) shall be provided where specified elsewhere, or as required by design of system. Power supplies shall be industrial type, size as required for the initial application plus 50% spare capacity unless noted otherwise.

B. Battery runtime shall be as specified elsewhere. If no other specification for battery runtime is specified, battery runtime shall be 12.5 minutes at full load.

C. UPSs shall be double-conversion, on-line type.

D. UPSs shall be rated for operation in -20 degrees C to 55 degrees C ambient temperatures.

E. UPS batteries shall be hot-swappable and 12-year rated when installed in 25 degrees C environment and 4-year rated when installed in 50 degrees C environment.

F. UPSs shall include dry contacts for the following alarm points:
   1. Loss of Input Power Alarm
   2. Low Battery Alarm

G. UPSs shall be manufactured by Falcon UPS or approved equal.

2.9 DISCONNECTS

A. A main disconnect switch or circuit breaker shall be supplied integral to all control panels. The main disconnect or circuit breaker shall be accessible/operable without exposing the operator to energized sections of the control panel(s), and shall be lockable in the open/off position.

B. Individual circuit breakers shall be provided integral to the manufactured control panel for each separate power circuit originating within the control panel.

C. Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated (or can be adjusted to is 1200A or higher, breakers shall be electronic trip and shall be provided with arc energy-reducing maintenance switching (with local status indicator) to reduce arc flash energy per NEC 240.87 requirements.

D. Manufacturers:
   1. Square 'D' or Cutler Hammer.

2.10 COMBINATION STARTERS

A. All combination starters shall utilize a unit disconnect. Magnetic starters shall be furnished in all combination starter units unless specifically shown otherwise. All starters shall utilize full NEMA/EEMAC rated contactors (size 1 minimum).

B. Starters shall be provided with a three-pole, external (door mounted) manual reset, solid state overload relay. Solid state overload relay shall have switch-selectable trip class and shall provide protection from:
   1. Overload.
   2. Phase Unbalance.
   3. Phase Loss.
   4. Ground Fault (Class II detection).

C. Unless specifically shown otherwise, each combination starter or each group of starters shall be furnished with a control circuit transformer including two primary protection fuses and one secondary fuse (in the non-ground secondary conductor). The transformer shall be sized to accommodate the contactor(s) and all connected control circuit loads (including motor space heaters and other similar loads where specified). The transformer rating shall be fully visible from the front when the unit door is opened. Unless otherwise indicated, control voltage shall be 120V AC. Control power shall be provided by individual unit control power transformers.

D. When a unit control circuit transformer is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.

E. Auxiliary control circuit interlocks shall be provided where indicated. Auxiliary interlocks shall be field convertible to normally open or normally closed operation.

F. NEMA/EEMAC Size 1-4 starters shall be mounted directly adjacent to the wireway so that power wiring (motor leads) shall connect directly to the starter terminals without the use of interposing terminals. Larger starters shall be arranged so that power wiring may exit through the bottom of the starter cubical without entering the vertical wireway.

G. Each starter shall be equipped with a minimum of the following control devices:
   1. Door-mounted reset button.
   2. Two (2) field-reversible (N.O./N.C.) auxiliary contacts
   3. For reversing and two-speed starters: Four (4) field-reversible (N.O./N.C.) auxiliary contacts
   4. Additional control devices as indicated on plans.

H. Control Wiring Terminal Blocks
   1. Terminal blocks shall generally be:
      a. Feed-thru, screw-in type
      b. DIN rail mounted
      c. Furnished with the stationary portion of the block secured to the unit bottom plate
      d. Furnished with unit-mounted control terminal blocks for each field wire.
      e. Rated for the voltage and current of the proposed application per UL/NEC standards.
      f. Sized (by supplier) for the associated wire gauges/types/quantities.
      g. Phoenix Contact UT-4 series, Weidmuller WDU-4 series (or equivalent) unless required otherwise by application.

I. Nameplates
   1. Each unit shall be properly labeled with an engraved phenolic nameplate with a white background and black letters.
   2. Each pilot device shall be properly labeled with a legend plate or an engraved phenolic nameplate.

J. Manufacturers:
   1. Square 'D' or Cutler Hammer.

2.11 WIRING

A. Refer to Section 16120 for all wiring types/applications.

B. All wiring shall be identified on each end with hot stamped, shrink tube type, or self-laminating vinyl permanent wire markers to correspond with numbering shown on wiring diagrams.

C. All connections shall be made on terminals with no splices.

D. All wiring runs shall be along horizontal or vertical routes to present a neat appearance. Angled runs will not be acceptable. Group or bundle parallel runs of wire in plastic wire duct where practical.

E. All wiring runs shall be securely fastened to the panel or wire duct by means of plastic wire ties. Adequately support and restrain all wire runs to prevent sagging or movement.

F. AC power wiring and instrumentation/analog wiring shall be run separate.

G. Color code all internal wiring (not field wiring) as follows:
1. Line and load circuits: Black (B)
2. AC control wiring: Red (R)
3. Externally-Powered control wiring: Yellow (Y)
4. Neutral wiring: White (W)
5. Low voltage DC(+)pos: Blue (BL)
6. Low voltage DC(-)neg: Blue/White Tracer (BL/W)
7. Grounding: Green (G)

H. Terminal strips shall be provided for all input and output wiring. No more than two (2) wires shall be connected to one (1) terminal block.

2.12 ELECTRICAL SURGE AND TRANSIENT PROTECTION

A. General
1. Function: Protect the system against damage due to electrical surges.

B. Application: As a minimum, provide surge and transient protection (with proper grounding) at the following locations as described below:
1. Power Input High Frequency Noise Filtering:
a. 120VAC Control panels with integral UPSs, PLCs, or other electronic/microprocessor equipment that is susceptible to failure or improper operation due to high frequency/harmonic input transients shall be provided with series-connected high-frequency noise filters on the line input (downstream of any panel main disconnects/breakers). Filters shall be as manufactured by Edco/Emerson/Islatrol or equal (exact type(s) as required by application).
2. Power Input Surge Protection:
a. Provide surge protection device at any connection of 120VAC power to panels containing programmable logic controllers, remote I/O equipment, UPS's, transmitters, radios, VFDs, Reduced Voltage Soft Starters or other electronic equipment. Device shall:
1) Be mounted internal to the associated panel, with dedicated overcurrent protection.
2) Be of two-part (base and SPD), DIN-rail mountable construction.
3) Have 15kA total nominal discharge current per line (based on 8/20µs waveform).
4) Have maximum continuous operating voltage (MCOV) rating as required by the associated circuit voltage.
5) Visually indicate operational status.

6) Be Dehn DEHNguard series or equal by MTL Technologies, or may be combined with the High Freqency Noise Filtering device required above.

b. Provide surge protection device at any connection of multi-pole AC power to panels containing programmable logic controllers, remote I/O equipment, UPS's, transmitters, radios, VFDs, Reduced Voltage Soft Starters or other electronic equipment. Device shall:
   1) Be mounted internal to the associated panel, with dedicated overcurrent protection.
   2) Provide protection for all phases.
   3) Have 40kA (per phase) peak surge current rating.
   4) Have maximum continuous operating voltage (MCOV) rating as required by the associated circuit voltage.
   5) Visually indicate operational status.
   6) Be Square D SDSA or HWA series or equal.

3. Analog I/O Panel Terminations Surge Protection:
   a. Provide surge protection device at the PLC (or similar) panel connection of each analog I/O signal. Device shall:
      1) Be mounted internal to the associated panel.
      2) Be of two-part (base and SPD), DIN-rail mountable construction.
      3) Have the following nominal discharge current ratings:
         a) D1 Lightning impulse current (10/350 µs) per line: 1 kA
         b) C2 Total nominal discharge current (8/20 µs): 20 kA
         c) C2 Nominal discharge current (8/20 µs) per line: 10 kA
      4) Have maximum continuous operating voltage (MCOV) rating as required by the associated signal.
      5) Manufacturer and Model:
         a) DEHN BSP M4 BE 24 (926 324) with 920300 base.
         b) Phoenix Contact 2801263 with included base.
         c) Weidmuller 1093400000 with 8951710000 base.
4. Discrete I/O Panel Terminations Surge Protection:
   a. Provide isolation relay at the PLC (or similar) panel connection of each discrete output signal (within the associated panel). See above for isolation relay requirements.
5. Low Voltage Power Supply Load Side Surge Protection:
   a. Provide surge protection device at the PLC (or similar) panel on the load side of each low voltage power supply that has low voltage connections extending external to the panel. Device shall:
      1) Be mounted internal to the associated panel.
      2) Be of two-part (base and SPD), DIN-rail mountable construction.
      3) Have 10kA total nominal discharge current per line (based on 8/20µs waveform).
      4) Have maximum continuous operating voltage (MCOV) rating as required by the associated utilization voltage.
      5) Be as manufactured by Dehn, MTL Technologies, or Phoenix Contact.
6. Network Panel Terminations Surge Protection:
   a. Provide surge protection device at the PLC (or similar) panel connection of each network cable. Device shall:
      1) Be mounted internal to the associated panel.
      2) Be of DIN-rail mountable construction.

3) Have 1kA total nominal discharge current per line (based on 8/20µs waveform).
4) Be designed specifically for the associated network connection type (Ethernet, RS485, RS232, etc.).
5) Be MTL Zonebarrier series or equal.

7. Antenna Cable Terminations Surge Protection:
   a. Provide surge protection device at the connection of antenna cable to the radio panel. Device shall:
      1) Be mounted internal to the associated panel.
      2) Provide coarse protection via replaceable gas-filled surge voltage arrestor
      3) Be Phoenix Contact CN-LAMBDA series or equal.

C. Installation and grounding of suppressor: As directed by manufacturer. Provide coordination and inspection of grounding.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE & HANDLING

A. Provide Site and warehouse storage facilities for all equipment.

B. Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers, and related equipment as recommended by the capsule manufacturer.

C. Prior to installation, store items in dry indoor locations. Provide heating in storage areas for items subject to corrosion under damp conditions.

D. Cover panels and other elements that are exposed to dusty construction environments.

3.2 INSTALLATION

A. Provide enclosure mounting supports as required for floor, frame or wall mounting. All supports in exterior, wet or process areas shall be stainless steel unless noted otherwise. All floor-mounted panels or other similar distribution equipment shall be mounted on 6" concrete housekeeping pads unless specifically shown otherwise. The general design intent is that centers of control panels be mounted at heights that are easily accessible. Design intent is that devices on panel fronts (pushbuttons, selector switches, pilot lights, HMIs, ETMs, breaker handles, etc.) generally be mounted as close to 5'-0"a.f.f. as possible, no higher than 6'-7"a.f.f (per NEC requirements) and no lower than 3'-6"a.f.f., where possible, without specific approval of the owner or engineer. Additionally, every effort shall be made to provide a professional, consistent, neat, and workmanlike finished appearance of panel installations. For example, tops of adjacent panels shall be mounted at matching heights where possible/reasonable.

B. All enclosures used outside shall be solid bottom unless otherwise specified. All cable and piping openings shall be sealed watertight. Cable and piping shall enter the enclosure as shown on drawings or specified herein.

C. All equipment and components shall be solidly grounded to the control panel. One grounded terminal unit shall be provided in each control panel for connection to plant

ground system. Grounding digital and analog components shall be performed in accordance with the instrument supplier's installation recommendations. Signal ground shall be solidly connected to the ground system so as to prevent ground loops

3.3 PAINTING

A. For enclosures other than NEMA 4X stainless steel or fiberglass:
   1. Completely clean all surfaces so that they are free of corrosive residue. Then, phosphatize all surfaces for corrosion protection.
   2. Prime with two (2) coats and finish with one coat of factory finish textured polyurethane. Paint shall be Sherwin-Williams Polane "T' or approved equal.
   3. Color to be selected during shop drawing review phase.

3.4 IDENTIFICATION & DOCUMENTATION

A. Refer to specification section 16075 for additional requirements.

B. Control panel power supply source, type, voltage, number or circuit ratings shall be identified inside control panels and on drawings.

C. All interior devices and components shall be identified with thermal transfer labels with black letters on white background. Labels shall be placed on the subpanel and not the component. Marking system shall be a Brother "PTouch II" or equal. Lettering shall be 1/4" high.

D. All front panel mounted devices such as push buttons shall be identified by the use of engraved bakelite nameplates or legend plates. Nameplates shall be 1/8" thick, white with black core.

E. Where a panel includes a PLC or other network-connected device that is intended to be connected to another system (such as a plant SCADA system) via a network connection, the panel supplier shall provide an Interface Control Document (ICD) to the other system supplier (such as the SCADA Integrator). This document shall itemize the following for each networked parameter that is capable of being monitored or controlled by the other system:
   1. Parameter Name/Function (ex: Pump No. 1 On/Off Status)
   2. Parameter Type (discrete or analog, input or output)
   3. Parameter register ID/location

F. Where a panel includes a touchscreen or other programmable HMI display and is to be monitored by another system (such as a plant SCADA system), the panel supplier shall provide copies of the HMI display code and screenshots of all proposed HMI screens to the other system supplier (such as the SCADA Integrator) for their use in duplicating the associated HMI.

G. A job-specific, custom wiring diagram for each control panel (not including control stations without relays) shall be provided to the contractor prior to installation for making the appropriate electrical connections. The wiring diagram shall clearly show all control components connected to the panel (whether the components are mounted internal or external to the enclosure). All wires and terminal blocks shall be clearly labeled. A laminated copy of the final wiring diagram for each unit shall be installed inside the door of the associated panel, and submitted to the owner with the as-built documentation.

3.5 OWNER TRAINING

A. Fully train the owner in the proper operation of all control panels/equipment, describing and demonstrating full operation, including function of each door-mounted device.

3.6 SPARE EQUIPMENT

A. Provide the following spare equipment:
   1. Fuses: 10% (minimum of 3) of each size and type utilized, mounted within a pocket within the associated control panel.
   2. Where control panel contains programmable controller (or similar equipment): Flash drive containing copies of all final programs utilized within the control panel, with provisions/cable assemblies as required to connect the flash drive provided to the controller to download the programs. Flash drive shall be attached to retractable cord (long enough to reach the associated port) attached to the inside of the panel door.

END OF SECTION 16480

SECTION 16511

LIGHTING MATERIALS AND METHODS

PART 1 GENERAL

1.1 DESCRIPTION

A. Lighting Fixtures

B. Drivers

1.2 SUBMITTALS

A. Complete submittals shall be provided identifying all lighting fixture types and options, all lamp types (where applicable) and compliance with all contract requirements. The absence of clear submittal information specifically listing exceptions/deviations from detailed contract requirements will be understood to indicated that the contractor/supplier intends to meet all contract requirements. Refer to specification section 16050 for additional requirements.

PART 2 PRODUCTS

2.1 GENERAL

A. Lighting fixtures shall be furnished as shown on plans and specified herein. It shall specifically be the responsibility of Contractor to verify exact types ceilings, walls, etc. and recessing depth of all recessed fixtures and furnish the specific mounting trims and accessories of the specified and/or accepted fixture specifically for the ceiling, wall etc. in which each fixture is to be installed.

B. Base bid manufacturers are listed on the lighting fixture schedule. Manufacturers listed without accompanying catalog numbers are responsible for meeting the quality standards, efficiency, maximum wattages and photometric distributions set by the specified product.

C. All lighting fixtures shall be so designed and shall have drivers and other similar items so installed as to function without interruptions or failures when operating in the environment in which they are proposed to be installed. Special attention shall be given to environments with potentially high ambient temperatures such as attic spaces, exterior soffits, confined interior soffits, coves, unconditioned spaces, etc. and shall be addressed by providing fixtures with suitable high ambient temperature ratings, remote mounting of drivers/ballasts, providing approved ventilation, etc. as directed by fixture manufacturer and approved by engineer, at contractor's expense.

D. All fixtures installed such as to create penetrations through fire rated ceiling or wall assemblies shall be labeled as suitable for that purpose or installed with covers, tenting or other means as required to maintain the fire rating of the assembly.

2.2 LED LUMINAIRES

A. For the purpose of these specifications, LED Luminaires shall be defined as the entire LED fixture assembly including LED array, drivers, housing, electronics, etc. that compose the lighting fixture.

B. Furnish and install LED Luminaire of proper size, type, efficacy, delivered lumen output, color temperature, distribution pattern, operational life, and CRI as shown on drawings.

C. LED Luminaires shall be tested in accordance with LM-79 and LM-80 standards.

D. LED drivers shall comply with NEMA 410 standards for inrush current, etc.

E. Exterior, pole mounted LED Luminaires shall be provided with an easily-serviceable, UL recognized surge protection device that meets a minimum 10kA Category C Low operation (IECC C62.41.2-2002). Device shall be wired in front of light engine(s) and driver(s) and shall fail "open" such as to prevent fixture operation after a surge protection failure.

F. LED Luminaires shall have a guarantee-warranty of at least five years unless specifically noted otherwise on contract documents.

G. LED Luminaire assembly shall comply with ambient temperature requirements specified in General section above.

2.3 STEMS/PENDANTS

A. Hangers shall be approved ball aligner type swivel, 30 degrees from vertical with swivel below canopy.

B. Stems/Pendants shall be rigid conduit unless specified otherwise on plans. Proposed stem/pendant types shall be submitted for review prior to shipment of light fixtures from factory.

C. Stems/Pendants shall be provided as required to prevent swaying of fixtures due to HVAC system airflow or other similar occurrences.

D. Shall be painted the same color as the fixture trim unless noted otherwise.

2.4 MANUFACTURER

A. Fixtures and stems shall be manufactured as shown in fixture schedule or approved equals.

B. Drivers shall be as manufactured by Philips/Advance, GE, Lutron, Magnatec, Motorola, EldoLED or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION OF LIGHTING FIXTURES

A. Support:

1. Support of all lighting fixtures shall be responsibility of electrical contractor. All lighting fixture supports shall be installed in accordance with lighting fixture supplier's recommendations.
2. Contractor shall submit typical hanging detail to Engineer before installing any fixtures.

B. Row-Mounted fixtures:
1. All stems on row-mounted fluorescent fixtures shall be installed as follows (except fixtures with slide grip hangers):
   a. One stem shall be installed in the first fixture knockout from end of row (on the first and last fixture of the row).
   b. One stem shall be installed between each two fixtures. Stem shall center joint where fixtures join and shall attach by use of "joining plates".
2. All fixtures in continuous rows other than recessed grid type shall be connected by nipples with locknuts bushings.

C. Coordination:
1. Contractor shall coordinate all dimensions & locations of light fixtures prior to rough-in to ensure proper fit and coordination with other trades.
2. Contractor shall verify exact ceiling types being installed and shall adjust fixture trim types accordingly (prior to submitting light fixture shop drawings).

END OF SECTION 16511

SECTION 16715

STRUCTURED CABLING SYSTEM

PART 1 GENERAL

1.1 SCOPE:

A. This document describes the products and execution requirements relating to furnishing and installing Telecommunications Cabling. Backbone and Horizontal cabling comprised of copper and fiber cabling, and support systems are covered under this document.

B. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the structured cabling contractor as detailed in this document.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types are indicated on the plans. If the bid documents are in conflict, this specification shall take precedence.

D. Refer to Specification Section 16075 (Electrical Identification) for additional identification requirements.

E. Refer to Specification Section 16116 (Auxiliary System Cables, 0-50V) for additional material and installation requirements.

1.2 REGULATORY REFERENCES:

A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the National Electrical Code, local ordinances and present manufacturing standards.

B. All materials shall be UL Listed and shall be marked as such. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

C. All modular jacks, patch cords, consolidation point, and patch cords shall be ETL Verified (not just tested) to be category 6 component and channel compliant.

D. The cabling system described in this specification is derived from the recommendations made in recognized telecommunications industry standards. The following documents are incorporated by reference:

1. ANSI/TIA/EIA - 568-B.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, April, 2001
2. ANSI/TIA/EIA - 568-B.2, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components, April, 2001
3. ANSI/TIA/EIA - 568-B.2-1, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted Pair Cabling Components, Addendum 1 – Transmission Performance Specifications for 4-pair 100 Ω Category 6 Cabling

4. ANSI/TIA/EIA - 568-B.3, Commercial Building Telecommunications Cabling Standard Part 3: Optical Fiber Cabling Components, March, 2000
5. ANSI/TIA/EIA – 569-E, Commercial Building Standard for Telecommunications Pathways and Spaces, 2019
6. ANSI/TIA/EIA – 606-A, Administration Standard for Telecommunications Infrastructure of Commercial Buildings, February, 2002
7. ANSI/TIA/EIA – 607-AJ, Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994
8. ANSI/ TIA/EIA – 758, Customer-Owned Outside Plant Telecommunications Cabling Standard, April 1999
9. BICSI - TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM) 10TH edition.
10. National Fire Protection Agency (NFPA – 70), National Electrical Code (NEC) – 2002
11. ANSI/TIA/EIA – 45-B, Test Procedures for Fiber Optic Connections.
12. ANSI/TIA/EIA – 526-14, Power Test for Fiber Runs.
13. FCC 47 CFR 68
14. NEMA 250
15. NEC Articles 770 and 800
16. ADA, Americans with Disabilities Act

E. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release.

F. This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project. All local State and federal codes are to be followed.

1.3 APPROVED CONTRACTOR:

A. The Structured Cabling Contractor must meet the following requirements:
1. Contractor must have a certified RCDD on staff. The project manager for this project shall have an RCDD certification, and RCDD shall be responsible for reviewing all aspects of the design, submittals and installation of all products.
2. All required submittal information shall be stamped by the RCDD.
3. Contractor must have a minimum of 3 years experience with projects of similar size and scope to this project.
4. The company performing the work must have been in business for a minimum of 3 years.
5. The company must have an office within 75 miles of the job site.

B. The Structured cabling contractor is responsible for workmanship and installation practices in accordance with the requirements of the standards described in these specifications and manufacturer's requirements.

1.4 WORK INCLUDED:

A. The work included under this specification consists of furnishing all labor, equipment, materials, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and

drawings. The structured cabling contractor will provide and install all of the required material to form a complete system whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install a complete telecommunications wiring infrastructure.
   2. Furnish, install, and terminate all UTP and Optical Fiber cable
   3. Furnish and install all wall plates, jacks, patch panels, and patch cords at equipment racks and at work outlets (unless shown otherwise on plans).
   4. Furnish and install all required cabinets and/or racks as required and as indicated.
   5. Furnish any other material required to form a complete system.
   6. Perform channel testing (100% of horizontal and/or backbone links/channels) and certification of all components.
   7. Furnish test results of all cabling to the owner on disk and paper format, listed by each closet, then by workstation ID.
   8. Provide owner test results and documentation. (Testing documentation and As-built drawings)

1.5 SUBMITTALS:

A. Within thirty (30) days of notice to proceed the structured cabling contractor shall submit the following items:
   1. Submit copies of the certification of the company and names of staff that will be performing the installation and termination of the installation to provide proof of compliance of this spec.
   2. Submit proof from manufacturer of contractor's good standing in manufacturer's certification program.
   3. Submit copy of contractor's RCDD certification.
   4. Submit listing of five (5) projects of similar size and scope to this project that have been completed within the last five years. Include in this submittal owner's contact information for each project.
   5. Submit letter from the manufacturer stating that the manufacturer will provide a twenty-five year (25) warranty in accordance with the requirements paragraph 1.03 (B) of these specifications.
   6. Submit appropriate cut sheets and samples for all products, hardware and cabling.
   7. Submit 1/8" = 1'-0" drawings of floor plans indicating all work outlets and the labeling designation for each jack.
   8. Submit ½" = 1'-0" drawings of each MDF and each IDF showing all racks, patch panels, 110 blocks, etc.

B. Work shall not proceed without the engineer's approval of the submitted items.

C. The structured cabling contractor shall receive approval from the engineer on all substitutions of material. No substituted materials shall be installed except by written approval from the engineer.

1.6 DRAWINGS:

A. It shall be understood that the electrical details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the structured cabling contractor in bidding the job. The

structured cabling contractor shall make allowance in the bid proposal to cover whatever work is required to comply with the intent of the plans and specifications.

B. The structured cabling contractor shall verify all dimensions at the site and be responsible for their accuracy.

PART 2 PRODUCTS

2.1 EQUIVALENT PRODUCTS:

A. Due to the nature and type of communications all products, including but not limited to faceplates, jacks, patch panels, racks, 110 blocks, and patch cords, for the purpose of this document, shall be manufactured by Hubbell, Ortronix, Panduit, Amp or Systimax. See below for acceptable cable manufacturers.

2.2 HORIZONTAL DISTRIBUTION CABLE:

A. Horizontal Distribution Cabling shall meet the following requirements:
   1. Shall be 100 Ohm Enhanced Category 6 Unshielded Twisted Pair (UTP) Cable.
   2. Physical Characteristics:
      a. Unless directed otherwise by owner (contractor shall verify with owner), Cat6 cable coloring shall be based on system type as follows, unless specifically approved otherwise:
         1) Data (or IP Voice): Blue
         2) Analog Voice: Grey
         3) Lighting Control System: White
         4) Fire Alarm or other Life-Safety System: Red
         5) CCTV Surveillance Cameras: Yellow
         6) Other: As directed by owner
      b. Shall be plenum-rated.
      c. Shall meet applicable requirements of ANSI/ICEA S-80-576.
      d. The diameter of the insulated conductor shall be .023 in. maximum.
      e. Shall consist of (4) 22-26 AWG twisted pairs.
      f. The overall diameter of the cable shall be no larger than 0.240 inches.
      g. The ultimate breaking strength measured in accordance with ASTM D 4565 shall be 400 N minimum.
      h. Cable shall withstand a bend radius of 1 inch at -20 degrees Celsius without jacket or insulation cracking.
      i. Cable shall be third party verified to meet ANSI/TIA/EIA-568-B.2-1.
      j. Where installed underground, within slab-on-grade or in exterior locations, be gel-filled and rated for wet locations.
   3. Transmission Characteristics:
      a. DC resistance of any conductor shall not exceed 9.38 Ohms per 100m max. at 20° C. Measured in accordance with ASTM D 4566.
      b. The mutual capacitance of any pair at 1 kHz for 100m of cable shall not exceed 4.4 nF nominal.
      c. DC resistance unbalance any two conductors of any pair shall not exceed 5% when measured at or corrected to 20° C in accordance with ASTM D 4566.
      d. Structural return loss swept measurement for 100m or longer shall meet or exceed Category 6 requirements.

4. Shall be manufactured by Amp NetConnect, Berk-Tek, Leviton, General Cable, Mohawk or Superior Essex.

2.3 BACKBONE - FIBER:

A. Backbone Fiber Optic Cabling shall meet the following requirements:
1. All optical fiber shall be Indoor/Outdoor,Tight-Buffered, All-Dielectric, Plenum rated (unless specified otherwise on plans) with Enhanced Multimode OM4-rated 50/125 Optical Fibers.
2. Each Multimode Fiber shall:
a. Be graded-index optical fiber wave-guide with nominal 50/125µm-core/cladding diameter.
b. Comply with ANSI/EIA/TIA-492AAAC-A
c. Have attenuation measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61.
d. Have information transmission capacity measured in accordance with ANSI/EIA/TIA-455-51 or 30.
e. Have measurements performed at 23 degrees C +/- 5 degrees.
f. Have Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.0
g. Have bandwidth $\geq$ 4700 MHz-km @ 850nm. (EMB)
h. Have bandwidth $\geq$ 500 MHz-km @ 1300nm.
i. Be laser optimized and guarantee a 1 Gb/s distance of 1000 meters @ 850nm and 10 Gb/s at 600 meters @ 850nm.
j. Terminate on fiber patch panel using SC Type fiber connectors.
3. Each indoor/outdoor fiber optic cable shall:
a. Be suitable for use in both outdoor and indoor applications without the use of a transition at the building entrance.
b. Be suitable for use in risers, plenums and horizontal applications.
c. Have a dry water blocking system for cable.
d. Have a fiber strand count of 12 (unless shown otherwise on plans).
e. Have a nominal 2.21 mm sub-unit diameter.
f. Have and be marked with an UL-OFNP Flame Rating (unless engineer specified otherwise on plans).
g. Comply with Bellcore GR-409 and GR20
h. Be independently verified to comply with ICEA S-104-696
i. Have strength members of FGE/Aramid yarn.
j. Be suitable for underground or above ground conduits.
k. (Where applicable) Have Tight Buffered fibers color coded in accordance with EIA / TIA 598 with an overall black jacket.
l. Be suitable for operation between -40° to +70° C
m. Be UV resistant
n. Be of an all dielectric design
4. Shall be manufactured by Berk-Tek, Corning, General Cable or Superior Essex.

2.4 COPPER CABLE SURGE PROTECTION DEVICES:

A. All copper circuits routed between or outside of buildings shall be provided with a surge protection device at each end. The surge protection device shall be labeled as meeting the requirements of the latest edition of UL 96A (exact requirements shall be coordinated with the lightning protection system supplier, where applicable).

B. The surge protection device shall be connected with a #6 AWG copper bonding conductor between the protector ground lug and the TC ground point.

2.5 PATCH CORDS:

A. The structured cabling contractor shall provide factory terminated and tested UTP and optical fiber patch cords and equipment cords for the complete cabling system. Patch cords shall be provided by the structured cabling contractor to connect patch panels to owner furnished electronics. The UTP patch cables shall meet the requirements of ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.2-1 for patch cord testing. Provide one set of optical fiber patch cables per fiber run that terminates on fiber patch panel and provide one category 6 patch cord for each category 6 work outlet that terminates on patch panel.

B. Copper (UTP) patch cords shall:
1. Be furnished to connect each patch panel jack to owner supplied electronics.
2. Be furnished for each work outlet jack.
3. Be a Category 6 patch cord manufactured by Panduit, Amp or Systimax.
4. Use 8 position connector with impedance matched contacts and designed using dual reactance.
5. Be constructed of 100 ohm, 4 pair, 24 AWG, stranded conductor, unshielded twisted pair copper per the requirements of the ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.2–1 standard.
6. Meet TIA category 6 component specifications in ANSI/TIA/EIA-568-B.2-1 100% factory tested to meet category 6 performance and ETL or any other nationally recognized 3rd party verification
7. Be capable of universal T568A or T568B wiring schemes.
8. Have modular connector that shall maintain the paired construction of the cable to facilitate minimum untwisting of the wires.
9. Have a performance marking indelibly labeled on the jacket (by the manufacturer).
10. Have the ability to accept color-coded labels and icons to comply with ANSI/TIA/EIA-606-A labeling specifications.
11. Have “snagless” protection for the locking tab to prevent snagging and to protect locking tab in tight locations and provide bend relief
12. Be available in three standard colors
13. Be available in 3 foot, 5 foot, 7 foot, 10 foot, and 14 foot standard lengths
14. Be backwards compatible to Category 3, 5 and 5e

C. Fiber Optic patch cords shall:
1. Be furnished in the quantity of two (2) per IDF in each IDF and two (2) per IDF in each MDF.
2. Be manufactured by Panduit, Amp or Systimax.
3. Be multimode OM4 type.
4. Have connector type as directed by owner.
5. Have a performance marking indelibly labeled on the jacket (by the manufacturer).
6. Have the ability to accept color-coded labels and icons to comply with ANSI/TIA/EIA-606-A labeling specifications.
7. Be available in three standard colors
8. Be available in 3 foot, 5 foot, 7 foot, 10 foot, and 14 foot standard lengths

PART 3 EXECUTION

3.1 PRE-INSTALLATION SITE SURVEY:

A. Prior to start of work, meet at the project site with the owner's representative and representatives of trades performing related work to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with the work. Facilitation with the General Contractor will be necessary to plan the crucial schedule completions of the equipment rooms and telecommunication closets.

B. Examine areas and conditions under which the system is to be installed. Do not proceed with work until satisfactory conditions have been achieved.

3.2 HORIZONTAL DISTRIBUTION CABLE INSTALLATION:

A. All horizontal voice and data cabling shall be terminated on modular patch panels except for horizontal voice cables serving life safety related functions (fire alarm systems, security systems, elevator communications, etc.). All horizontal voice cabling serving life safety related functions shall be terminated on 110 blocks.

B. The voice and data cables shall be installed in separate patch panels.

C. All wiring above ceilings shall be installed in cable tray or open top cable hangers or in provided conduit.

D. Cable above accessible ceilings shall be supported 60" on center from cable support attached to building structure.

E. Do not untwist cable pairs more than 0.5 in. when terminating.

F. The Contractor shall be responsible for replacing all cables that do not pass Category 6 requirements for data and 5e for the voice applications.

G. Maximum horizontal cable length shall be 90 meters.

H. Cable shall have no physical defects such as cuts, tears or bulges in the outer jacket. Cables with defects shall be replaced.

I. Install cable in neat and workmanlike manner. Neatly bundle and tie all cable in closets. Leave sufficient cable for 90° sweeps at all vertical drops.

J. Do not install Category 6 cable with more than 110N (25 lbs) pull force, as specified in ANSI/TIA/EIA and BICSI TDDM practices. Utilize appropriate cable lubricant in sufficient quantity to reduce pulling friction to acceptable levels on long pulls inside conduit, pulls of multiple cables into a single small bore conduit, on conduit runs greater than 100 lineal feet with bends of opposing directions, and in conduit runs that exceed 180 degrees of accumulated bends. Use of tensile rated cords (i.e. fishing line) should be used for difficult or questionable pulls - to judge to go/no-go condition of the conduit and pulling setup.

K. Cables jackets that are chaffed or burned exposing internal conductor insulation or have any bare copper ("shiners") shall be replaced.

L. Test, label and document as called for in contract documents.

M. Firestop all openings where cable is installed through a fire barrier.

3.3 OPTICAL FIBER TERMINATION HARDWARE:

A. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

B. Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.

C. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.

D. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.

E. A maximum of 12 strands of fiber shall be spliced in each tray

F. All spare strands shall be installed into spare splice trays.

3.4 BACKBONE CABLE INSTALLATION:

A. Raceways:
1. Backbone cables shall be installed separately (in separate innerducts/conduits) from horizontal distribution cables.
2. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

3.5 COPPER TERMINATION HARDWARE:

A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-A/B standard, manufacturer's recommendations and best industry practice.

B. Pair untwist at the termination shall not exceed 12 mm (one-half inch).

C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

E. The cable jacket shall be maintained to within 25 mm (one inch) of the termination point.

F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.6 IDENTIFICATION AND LABELING:

A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the successful structured cabling contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. Labeling shall follow the guidelines of ANSI/TIA/EIA-606-A.

B. All label printing will be machine generated by Panduit software (or other) using indelible ink ribbons or cartridges. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.

3.7 TESTING AND ACCEPTANCE:

A. General
1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
2. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards, the Panduit Certification Program Information Manual and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

B. Copper Channel Testing
1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using a Level III test unit for category 6 performance compliance, respectively.
2. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
3. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B.1 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.

4. Category 6 Performance:
   a. Follow the Standards requirements established in:
      1) ANSI/TIA/EIA-568-B .1, B.2 and B.2-1
   b. A Level III test unit is required to verify category 6 performance.The basic tests required are:
      1) Wire Map
      2) Length
      3) Attenuation
      4) NEXT (Near end crosstalk)
      5) Return Loss
      6) ELFEXT Loss
      7) Propagation Delay
      8) Delay skew
      9) PSNEXT (Power sum near-end crosstalk loss)
      10) PSELFEXT (Power sum equal level far-end crosstalk loss)

C. Fiber Testing
   1. All fiber testing shall be performed on all fibers in the completed end to end system. There shall be no splices unless clearly defined in an RFP. Testing shall consist of an end to end power meter test performed per EIA/TIA-455-53A. The system loss measurements shall be provided at 850 and/or 1300 nanometers for multimode fibers and 1310 and/or 1550 nanometers for single mode fibers. These tests also include continuity checking of each fiber.
   2. Backbone multimode fiber cabling shall be tested at both 850 nm and 1300 nm (or 1310 and 1550 nm for singlemode) in both directions.
   3. Test set-up and performance shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, Method B.
   4. Where links are combined to complete a circuit between devices, the structured cabling contractor shall test each link from end to end to ensure the performance of the system. ONLY LINK TEST IS REQUIRED. The structured cabling contractor can optionally install patch cords to complete the circuit and then test the entire channel. The test method shall be the same used for the test described above. The values for calculating loss shall be those defined in the ANSI/TIA/EIA Standard.
   5. Attenuation testing shall be performed with an approved hand held tester from an industry recognized test equipment manufacturer.

3.8 SYSTEM DOCUMENTATION:

A. Upon completion of the installation, the structured cabling contractor shall provide three (3) full documentation sets to the owners for approval. Documentation shall include the items detailed in the sub-sections below.

B. Documentation shall be submitted within ten (10) working days of the completion of each testing phase (e.g. subsystem, cable type, area, floor, etc.). This is inclusive of all test result and draft as-built drawings. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase. At the request of the Engineer, the structured cabling contractor shall provide copies of the original test results.

C. The Engineer may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the structured cabling contractor, additional testing can be requested to the extent determined necessary by the Engineer, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

3.9 TEST RESULTS:

A. Test documentation shall be provided on disk within three weeks after the completion of the project. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

B. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-A/B including applicable TSB's and amendments. The appropriate Level III tester shall be used to verify Category 6 cabling systems.

C. Test results generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. The structured cabling contractor must furnish this information in electronic form (CD-ROM).

D. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

3.10 AS-BUILT DRAWINGS:

A. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD rel. 2002) formats on which as-built construction information can be added. These documents will be modified accordingly by the structured cabling contractor to denote as-built information as defined above and returned to the Owner.

B. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD DWG) form.

3.11 WARRANTY:

A. The manufacturer shall provide a 25 year extended product warranty with a 25 year applications assurance warranty. Manufacturer shall provide the warranty directly to the end user.

B. An Extended Product Warranty shall be provided which warrants functionality of all components used in the system for 25 years from the date of registration. The Extended Product Warranty shall warrant the installed horizontal copper and the backbone optical fiber portions of the cabling system.

C. The Application Assurance Warranty shall cover the failure of the wiring system to support current or future applications that are designed for the link/channel specifications of ANSI/TIA/EIA–568-B.1. These applications include, but are not limited to, 10BASE-T, 100BASE-T, 1000BASE-T, and 155 Mb/s ATM.

D. The contractor shall provide a warranty on the physical installation.

3.12 FINAL ACCEPTANCE & SYSTEM CERTIFICATION:

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation, and successful performance of the cabling system for a two week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, the end user shall be provided with a numbered certificate, from the manufacturer, registering the installation.

END OF SECTION 16715

SECTION 16850

ELECTRICAL HEAT TRACING SYSTEMS

PART 1 GENERAL

1.1 SCOPE

A. This specification covers the requirements of materials and support services for heat-tracing systems. Heat tracing systems (including insulation and all accessories) shall be provided on all piping installed exposed in exterior locations or where otherwise indicated on plans unless noted otherwise.

1.2 CODES, APPROVALS, AND STANDARDS

A. The electric heat-tracing system shall conform to this specification. It shall be designed, manufactured, and tested in accordance with the applicable requirements of the latest edition of the following codes and standards.

1. ANSI American National Standards Institute
2. CEC Canadian Electrical Code
3. CSA CSA International
4. FM FM Approvals
5. IEC International Electro-Mechanical Commission
6. IEEE Institute Of Electrical and Electronics Engineers
7. ITS Intertek Testing Services (Intertek ETL SEMKO)
8. NEC U.S. National Electrical Code (NFPA 70)
9. NEMA National Electrical Manufacturers Association
10. NESC National Electrical Safety Code
11. UL Underwriters' Laboratories, Inc.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Heat Tracing:

1. Raychem/Tyco Thermal Controls.
2. Thermon.
3. Nelson Heat Tracing.
4. Chromalox.

B. Insulation:

1. Armstrong World Industries, Inc.
2. Babcock & Wilcox; Insulationg Products Division
3. CertainTeed Corporation
4. Knauf Fiber Glass GmbH
5. Manville Products Corp.
6. Owens-Corning Fiber Glass Corp.
7. Pittsburg Corning Corp.
8. Rubatex Corp.

2.2 SELF-REGULATING HEATING CABLES

A. All heat-tracing applications with continuous exposure (maintain) temperatures from 150°F (65°C) to 250°F (121°C) or intermittent exposure temperatures from 185°F (85°C) to 420°F (215°C) shall use self-regulating cables.

1. Self-regulating heating cable shall vary its power output relative to the temperature of the surface of the pipe or the vessel. The cable shall be designed such that it can be crossed over itself and cut to length in the field.
2. Self-regulating heating cable shall be designed for a useful life of 20 years or more with "power on" continuously, based on the following useful life criteria:
   a. Retention of at least 75 percent of nominal rated power after 20 years of operation at the maximum published continuous exposure (maintain) temperature.
   b. Retention of at least 90 percent of nominal rated power after 1000 hours of operation at the maximum published intermittent exposure temperature. The testing shall conform to UL 746B, IEC 216-1 Part 1.
3. A warranty against manufacturing defects for a period of 10 years shall be available.
4. All cables shall be capable of passing a 2.5 kV dielectric test for one minute (ASTM 2633) after undergoing a 0.5 kg-m impact (BS 6351, Part 1, 8.1.10).

2.3 FREEZE-PROTECTION SYSTEMS

A. The heating cable shall consist of two 16 AWG or larger nickel-plated copper bus wires, embedded in a self-regulating polymeric core that controls power output so that the cable can be used directly on plastic or metallic pipes. Cables shall have a temperature identification number (T-rating) of T6 (185°F or 85°C) without use of thermostats.

B. The heating cable shall have a tinned copper braid with a resistance less than the heating cable bus wire resistance as determined in type test (ASTM, B193, Sec. 5). The braid shall be protected from chemical attack and mechanical abuse by a modified polyolefin or fluoropolymer outer jacket.

C. In order to provide rapid heat-up, to conserve energy, and to prevent overheating of fluids and plastic pipe, the heating cable shall have the following minimum self-regulating indices:

1. Table K.1 Minimum Self-Regulating Indices

Heating cable	S.R. index (W/°F)	S.R. Index (W/°C)
3 W/ft	0.038	0.068
5 W/ft	0.060	0.108
8 W/ft	0.074	0.133
10 W/ft	0.100	0.180

D. The self-regulating index is the rate of change of power output in watts per degree Fahrenheit or watts per degree Celsius, as measured between the temperatures of 50°F (10°C) and 100°F (38°C) and confirmed by the type test and published data sheets.

1. In order to ensure that the self-regulating heating cable does not increase power output when accidentally exposed to high temperatures, resulting in thermal runaway and self- ignition, the cable shall produce less than 0.5 watts per foot (1.64 watts per meter) when energized and heated to 350°F (177°C) for 30 minutes. After this test, if the cable is reenergized, it must not have an increasing power output leading to thermal runaway.

2. In order to confirm 3.1B, the self-regulating heating cable shall retain at least 90 percent of its original power output after having been cycled 300 times between 50°F (10°C) and 210°F (99°C), allowing at least six minutes of dwell time at each temperature.
3. The heating cable shall be Raychem® BTV-CT or BTV-CR self-regulating heater, with continuous exposure (maintain) capability up to 150°F (65°C) and intermittent exposure capability up to 185°F (85°C), as manufactured by Tyco Thermal Controls.

2.4 SYSTEMS FOR DIVISION 1 HAZARDOUS LOCATIONS

A. The following requirements shall apply in addition to the criteria specified above:
1. The self-regulating heating cable shall be specifically FM Approved or CSA Certified for use in Division 1 locations.
2. A ground-fault protection device set at 30 mA, with a nominal 100 ms response time, shall be used to protect each circuit.
3. The temperature identification number (T-rating) of the cable used shall comply with FM and CSA requirements as applicable.
4. Connection methods used with the cable shall be compatible and approved as a part of the system manufactured and supplied by the heating cable vendor for use in the Division 1 location.
5. For plastic pipe and vessel applications, the heating cable shall be Raychem HBTV-CT or Raychem BTV-CT self-regulating heaters, with continuous exposure capability up to 150°F (65°C) and intermittent exposure capability up to 185°F (85°C), as manufactured by Tyco Thermal Controls.
6. The heating cable shall be Raychem HQTV-CT or Raychem QTVR-CT self-regulating
heaters, for continuous and intermittent exposure capability up to 225°F (110°C), as manufactured by Tyco Thermal Controls.

B. Terminations for nonhazardous And hazardous class 1, div 2 locations
1. All connection components used to terminate heating cables, including power connectors, splices, tees, and connectors shall be approved for the respective area classification and approved as a system with the particular type of heating cable in use. Under no circumstances shall terminations be used which are manufactured by a vendor other than the cable manufacturer.
2. In order to keep connections dry and corrosion resistant, components shall be constructed of nonmetallic, electrostatic, charge-resistant, glass-filled, engineered polymer enclosure rated NEMA 4X. The component stand shall allow for up to four inches (100 mm) of thermal insulation.
3. Terminals shall be spring clamp wire connection type to provide reliable connection, maintenance-free operation, and ease of reentry.
4. Heating cable terminations shall use cold-applied materials and shall not require the use of a heat gun, torch, or hot work permit for installation.
5. Components shall be rated to a minimum installation temperature of –40°F (–40°C), minimum usage temperature of –75°F (–60°C), and maximum pipe temperature of 500°F (260°C).
6. The component system shall be Raychem JBM-100-L-A connection kit complete with integral LED power indicating light to serve as complete power, splice, or tee connection for up to three Raychem BTV, QTVR, or XTV industrial parallel heating cables as manufactured by Tyco Thermal Controls.

2.5 THERMOSTATS AND CONTACTORS

A. Freeze protection systems shall operate using self-regulating control or with the DigiTrace AMC-1A or DigiTrace AMC-F5 thermostat and the DigiTrace E104-100A or DigiTrace E304-40A contactor in nonhazardous locations, and DigiTrace AMC-1H thermostat with Digitrace E307-40A contactor in hazardous locations, as supplied by Tyco Thermal Controls.

B. Where heat tracing is applied to emergency showers and/or emergency eye wash systems (or other systems where the heated piping system provides water that may be applied to persons in emergency or non-emergency situations), the sensor (that determines whether the heat tracing system is ON or OFF) shall be placed on the associated pipe or tank wall rather than in ambient air (such as to prevent the heat tracing system from overheating the associated liquid).

2.6 END SEAL

A. An above-insulation, lighted end seal kit shall be provided for each heat trace circuit termination as per the manufacturer's installation details. The kit shall be E-100-LBTV2 as supplied by Tyco Thermal Controls.

2.7 INSULATION

A. All components of the insulation, including covering, mastics and adhesives shall have a flame-spread rating of not over 25, and a smoke development rating of not over 50. Ratings shall be as established by tests in accordance with ASTM E 84 and Federal Specification standards. The integrated insulation assemblies shall also conform to the above specifications. Insulation shall be applied in strict accordance with the manufacturer's instructions.

B. Description:

1. This type of insulation shall be employed for process, cold-and hot water, steam, and condensate piping and equipment with surface temperatures up to 850 degrees F. Pipe insulation and jacketing shall be applied to piping where shown, and shall include fittings, flanges, and valves. Pipe insulation shall be molded-type pipe covering, made of fibrous glass with a minimum k-factor of 0.23 at 75 degrees F mean temperature. Unless otherwise specified the insulation thickness shall be 1" minimum.
2. The insulation shall be oversized for installation over electric heating cable. Insulation shall have a factory-applied white fire-retardant vapor-barrier jacket of kraft paper and aluminum foil laminated together and reinforced with fiberglass yarn. Fittings and valves shall be covered with the same material as the pipe, cut in segments to fit snugly without open spaces, held in place with copper wire or cement, and then covered with the same jacketing material as the pipe. Insulated fittings adjacent to vapor-barrier insulation shall be sealed with an acceptable vapor-barrier cement before installation of the finish jacket. Pipe insulation and vapor-barrier shall be continuous through hangers and supports. Insulation shall be coordinated with the pipe hangers and supports and where insulation protection shields are provided the top half section of pipe insulation at support locations shall be of the same specified density, and the bottom half insulation segments provided between the pipe and the insulation protection shields shall have a density of not less than 6 lb/cu ft. All insulation shall be covered with

smooth aluminum weatherproof metal or plastic preformed jacketing with a factory attached moisture barrier. The jacket for the fittings shall consist of precision-formed smooth-sided sections and shall be sized to cover and protect the insulated fitting. Each section shall be manufactured from aluminum or PVC, and all joints shall be sealed with silicon mastic or solvent welding, to provide a continuous, air and weathertight joint. Strapping shall be 1/2-inch wide, Type 3003 aluminum or stainless steel.

PART 3 EXECUTION

3.1 GENERAL

A. Heat tracing shall be provided along full length of all exposed piping or vessels located outside of buildings or in other areas designated on plans (such as by insulated piping in areas subject to cold temperature). Insulation shall be provided over all heat traced pipes.

B. The vendor shall provide a detailed design utilizing standard heat-tracing design software, such as Tyco Thermal Controls TraceCalc® Pro design software or equal. At minimum, the design must provide the following:
1. Circuit identification number
2. Maintain temperature
3. Line size and insulation
4. Heat loss for pipe, valves, and supports
5. Amount and type of heating cable required
6. Spiral requirements
7. Heating cable service voltage
8. Heating cable power output at the maintain temperature
9. Minimum and maximum maintain temperature vs. minimum and maximum ambient temperatures
10. Circuit breaker and transformer sizing

C. A ground-fault protection device set at 30 mA, with a nominal 100-ms response time, shall be used to protect each circuit.

D. Install additional heating tape at bolted flanges, valves, pipe supports, and other fittings and fixtures as recommended by supplier, but not less than the following:
1. Bolted flanges (per pair): Two times pipe diameter
2. Valves: Four times valve length
3. Pipe hanger or support penetrating insulation: Three times pipe diameter

E. The entire system shall be installed in compliance with the manufacturer’s recommendations for a fully-functional, code-compliant system.

F. All insulation shall be installed by a qualified insulation contractor in strict accordance with the manufacturer's recommendations and the requirements of these specifications.

G. All piping insulation shall be installed following required testing and approval of piping.

3.2 IDENTIFICATION

A. Heat tracing systems shall be labeled at the field connection of power to the heat tracing equipment per the requirements for Utilization Equipment within Specification Section 16075.

B. Heat traced piping, vessels, etc. shall be identified with appropriate caution signs or markings at intervals not exceeding 20 feet on center per NEC requirements.

3.3 TESTING

A. Factory inspections and tests for self-regulating, power limiting, series constant wattage and constant wattage (MI) heater cables shall include but are not limited to the following:
   1. Testing shall be done per the latest IEEE Std. 515 test section and applicable manufacturer's standards.
   2. In the field, all heater cables shall be meggered. The following separate field megger readings shall be taken on each self-regulating and each M.I. heater cable:
      a. Heater cable shall be meggered when received at jobsite before installation.
      b. Heater cable shall be meggered after installation, but before insulation is applied.
      c. Heater cable shall be meggered after insulation has been installed.
   3. All three of the above field megger readings shall be greater than 20 megohms. Otherwise, the heater cable is not acceptable and shall be replaced.
   4. Field megger tests shall be recorded for each heater cable, and certified reports shall be submitted to the user.

END OF SECTION 16850

Appendix A

SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING EVALUATION

Walnut Creek WWTP Tertiary Filtration Equipment Upgrade

September 18, 2024

PREPARED FOR

City of Troy
P.O. Box 549
Troy, Alabama 36081

PREPARED BY

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September 18, 2024

City of Troy
P.O. Box 549
Troy, Alabama 36081

Attention: Mayor Jason Reeves

Reference: **Report of Subsurface Exploration and Geotechnical Engineering Evaluation**
Walnut Creek WWTP Tertiary Filtration Equipment Upgrade
Troy, Alabama
CDG Reference Number: R021022458

Dear Mayor Reeves:

CDG, Inc. (CDG) has completed the authorized subsurface exploration and geotechnical engineering evaluation for the proposed Walnut Creek WWTP Tertiary Filtration Equipment Upgrade project in Troy, Alabama. Our services were performed in general conformance to a *Scope of Work Document* included with an *Agreement Between Owner and Engineer for Professional Services* dated 9/13/23.

The purposes of this study were to determine general subsurface conditions at specific soil test boring locations and to provide geotechnical recommendations relative to the site work and foundation phases of construction. This report presents the subsurface conditions encountered at the boring locations, laboratory test results of representative, on-site soil samples, and our recommendations associated with the proposed development.

We appreciate the opportunity to work with you and look forward to our continued involvement during the construction phase of the project. Please call if you have any questions or need additional information.

Respectfully Submitted,
CDG, Inc.

K. Taylor Griffin, EI
Project Professional

Allen J. Yates, PE
Senior Engineer



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Appendix B – Boring Location Plan
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1.0 SCOPE OF SERVICES

In general, our services included performing a subsurface exploration, conducting field and laboratory soil tests, and preparing a geotechnical engineering report of our findings. Following is the specific scope of services performed for the Walnut Creek WWTP Tertiary Filtration Equipment Upgrade project:

- Site reconnaissance, soil test boring layout, and geologic map review.
- Mobilization of an ATV-mounted drilling rig and soil test borings in the vicinity the proposed tertiary filtration basin. Two (2) borings were performed on July 9, 2024 and contained Standard Penetration Tests (SPT) at 2½-foot intervals in the upper 10 feet and on 5-foot centers thereafter. The borings extended to approximately 30 feet below the existing ground surface, at which depth the borings were terminated.
- Laboratory tests to determine site-specific soil classification characteristics. Tests included the following: Natural Moisture Content (5 tests), Grain Size Analysis (2 tests), Atterberg Limits (2 tests).
- One (1) piezometer was installed in boring B-1 to establish a delayed depth to groundwater.
- Evaluation of the information gathered during the subsurface exploration and laboratory testing program and preparation of this geotechnical engineering report. The report addresses the following items:
    - Site and project descriptions;
    - Local geology and its implications for the planned development;
    - Subsurface conditions encountered in the borings;
    - Groundwater measurements at the time of the fieldwork and delayed measurements at the piezometer location;
    - Laboratory test results;
    - Earthwork recommendations including subgrade preparation, excavation and fill placement, treatment of unsuitable soils, and groundwater control;
    - Foundation recommendations including type and soil support parameters, expected total and differential settlements, and foundation construction considerations;
    - Floor slab support and modulus of subgrade reaction recommendations.

The current geotechnical scope of services did not include an environmental assessment of the site to determine the presence of wetlands, hazardous materials, buried wastes, contaminated soil, etc. An environmental assessment can be provided if requested by the client.

2.0 SITE AND PROJECT DESCRIPTION

The proposed wastewater treatment plant equipment upgrade is located in the southeastern quadrant of Section 10, Township 9 North, Range 21 East in Troy, Pike County, Alabama. Specifically, the site is located along Walnut Creek Circle within the existing Walnut Creek wastewater treatment facility. The proposed improvements are bound by an existing UV disinfection basin to the northwest and maintained, grassed areas on all other sides. A *Site Vicinity Map* is included in **Appendix A**.

At the time of the field work (July 9, 2024), the area of improvements was, as noted, vegetated with short grasses. The site appeared to have been previously graded to construct the nearby, existing wastewater treatment plant structures. A barbed wire fence was observed around the existing site. Overhead utilities were observed along the northwest edge of the plant and heading north going right over the proposed tertiary filtration equipment. Various utilities were observed around the existing structures.

Available topographic information [*Site Layout (60% Plans);* dated May 2024] indicate that the point of highest elevation (EL 370') is located on the north side of the site north of the existing clarifier No. 2. The point of lowest elevation (EL 351') occurs at the south end of the site south of the existing drying beds. Therefore, the site generally slopes from north to south away. The elevation at the proposed filter location is approximately EL 356.5'. The following pictures indicate typical site conditions at the time of the fieldwork.



Looking East
(Proposed Filtration Equipment Area)



Looking West
(Proposed Filtration Equipment Area)

The proposed improvements include a tertiary filtration basin with plan dimensions of approximately 17'x22' (including the influent channel) and a maximum height of ±20 feet. Total and differential settlement tolerances were specified as 1 inch and ½ inch, respectively. Specific structural loads were not provided at the time of report preparation. However, the maximum water height within the basin is expected to be ±18½ feet. Therefore, we have assumed maximum ground pressures exerted by the basin will not exceed 2,000 psf.

Based on review of available plans (*Filtration System Detail Section Views*; sheet C-414; dated May 2024), we understand the floor elevation of proposed basin bottom will be EL 355.00'. Therefore, accounting for the thickness of the basin slab, earthwork to facilitate construction of the filter is expected to include cuts on the order of 2 to 3 feet. Deeper excavations may be required for installation of utility piping.

3.0 FIELD AND LABORATORY TESTING

3.1 Soil Test Borings

The field investigation included performing two (2) soil test borings in the vicinity of the proposed filter. The sampling and penetration procedures of the soil test borings were performed in general accordance with ASTM D-1586, using an ATV-mounted drilling rig. Standard Penetration Tests (SPT) were performed in the soil borings by driving a standard 1⅜-inch inside diameter and 2-inch outside diameter split spoon sampler with a 140-pound hammer falling 30 inches.

The number of hammer blows required to drive the sampler a total of 18 inches, in 6-inch increments, were recorded. The penetration resistance, or "N" value, is the sum of the blows required to drive the sampler the final two 6-inch increments. The N-values are indicated on the boring logs in adjacent to their corresponding depths. The penetration resistance is used as an indicator of various soil parameters from empirical correlations.

3.2 Laboratory Testing

During the field investigation, a representative portion of each recovered sample was sealed in plastic bags and transported to our laboratory for engineering classification (ASTM-2487) and laboratory testing. The description and stratification of the soil conditions, using the Unified Soil Classification System, are illustrated in the form of soil profiles on the *Boring Logs* in **Appendix C**. To aid in soil classification and determining site-specific soil characteristics, selected soil samples were tested for natural moisture content (ASTM D-2216), Particle Size Analysis (ASTM D-6913), and Atterberg Limits (ASTM D-4318). Details of the laboratory testing are included in **Appendix D**.

4.0 LOCAL GEOLOGY

A review of geologic data (digital GIS data provided by the USGS) indicates that the site is located in the Coastal Plain Province. Soils of the Coastal Plain appear to have been deposited in an ancient marine environment and the rock, where present, is relatively low-grade sedimentary (often soft, sandy limestone). The site is primarily located within the Clayton Formation but is also partially underlain by more recent deposits termed alluvial, coastal, and low terrace deposits. A *Site Geology & Documented Sinkhole Plan* is provided in **Appendix A**.

The upper part of the Clayton Formation (McBryde Limestone Member) consists of white to yellowish-gray, argillaceous (clay containing) limestone. The lower part consists of medium-gray, fossiliferous (containing fossils), calcareous (containing calcium carbonate) silt, glauconitic (an iron-potassium mineral of green color which is friable and exhibits a very low weathering resistance) sand and thin beds of sandy limestone and calcareous sandstone (Pine Barren Member). At the base of the formation in southeast Alabama is a gravelly, medium to coarse sand containing clay pebbles.

Alluvial, coastal and low terrace deposits refer to relatively recent (Quarternary), water-deposited soil typically associated with ancient or existing rivers, streams, and other waterways. The existing treatment facility is located adjacent to Walnut Creek. Therefore, the deposits at the site appear to have resulted from the meanderings and flooding of that creek. The soils generally consist of fine to coarse, quartz sand with clay lenses and some gravel. Due to relatively recent deposition, alluvium and low terrace deposits often exhibit a low consistency.

Clays in the Coastal Plain Province and within the terrace deposits can exhibit a high plasticity. Plasticity is a measure of a soil's potential for volume change. Plastic soils shrink and swell with variations in natural moisture content. Additionally, springs are often encountered in the geologic formations present at the site. Springs typically develop when water becomes trapped in the porous sands overlying relatively impermeable silts and clays. They can be present continually; however, additional springs and greater flow rates are generally present during periods of high rainfall.

Subsurface voids (dolines), depressions, and sinkholes occur in geologic formations containing soluble rock such as limestone and calcareous sandstone. These formations are known as karst geologies. Circulating groundwater dissolves the carbonate portion of the rock over geologic time. As the carbonate portion of the rock dissolves, voids and caverns develop underground. The doline can propagate upward toward the ground surface and can result in subsidence or collapse of the overlying soil. Groundwater movement causing erosion of soil overburden is typically necessary for the formation of dolines in the karst geologies of Alabama. Available sinkhole data (digital GIS data from the Geological Survey of Alabama) indicates that sinkholes have been documented within ±2 miles of the site. A portion of the data has been reproduced on the *Site Geology and Documented Sinkhole Plan*.

Due to the underlying geologic formation, there is a risk of future sinkhole activity at the site. However, no evidence of ground surface subsidence was observed at the site during the field work. Therefore, the risk of sinkhole development appears to be no greater at the subject site than at surrounding locations. However, we note that the action of sinkholes is irregular and cannot be precisely predicted. Therefore, the site should be carefully monitored for subsidence, depressions, and sinkholes. Additional engineering evaluation and remediation will be required should further evidence of sinkhole activity be observed at the site during or after construction.

5.0 SUBSURFACE CONDITIONS

The subsurface exploration included two (2) soil test borings at the proposed filtration equipment. The boring locations were established in the field using hand-held GPS equipment and available site layout information (*Preliminary WWTP Site Layout*; provided on 12/11/23*;* prepared by CDG). Therefore, the boring locations indicated on the *Boring Location Plan* in **Appendix B** are approximate.

Details of the conditions encountered at the boring locations are contained on the *Boring Logs* in **Appendix C**. The stratification lines indicated on the logs represent the approximate boundaries between soil types. The actual transitions may be gradual. The soil conditions noted on the logs represent conditions encountered at the location and time tested. Significant changes in subsurface conditions can occur over a short distance or period of time. The general subsurface conditions encountered at the test locations are described below.

5.1 Topsoil

As previously indicated, the site was generally vegetated with short grasses at the time of the field work. Therefore, an upper zone of topsoil and rootmat was initially encountered at the boring locations. The thickness of the upper, organic soil measured approximately 6 inches at both test locations.

5.2 Existing Fill

Previously placed fill was encountered at both boring locations. The fill appears to be associated with the existing development on the site. The fill extended to depths ranging from approximately 3½ to 6 feet below the existing ground surface.

The existing fill was encountered immediately beneath the topsoil and consisted of silty sand, some of which contained gravel sized particles. Standard Penetration Test (SPT) N-values in the fill ranged from 7 to 23 blows per foot (bpf) and averaged 15 bpf. Therefore, the existing fill exhibited a loose to medium dense consistency.

The natural moisture contents of selected samples of the fill were 4% and 8%. A tested sample of the existing fill was non-plastic. The sample contained 20.1% fine-grained (silt and clay size) particles. Based on USCS classification guidelines, the fill sample classified as silty sand (SM).

5.3 Coastal Plain Deposits

Coastal Plain Deposits are naturally occurring soils that appear to have formed by the gradual deposition of sediment in an ancient marine environment. Deposits associated with the Clayton Formation were encountered underlying the existing fill at both (2) boring locations. The deposits extended to depths of 30 feet below the existing ground surface.

As encountered in the borings, the deposits primarily consisted of clayey sand or sandy silt and clay. SPT N-values in the fill ranged from weight-of-hammer (WOH) to 32 blows per foot (bpf) and averaged 16 bpf. Weight-of-hammer indicates that the spoon sampler dropped through the designated test interval without the need for hammer impact. The unconfined compressive strengths (PP_{qu}) of cohesive samples were measured using a hand-held penetrometer. PPqu values within cohesive samples of the deposits ranged from 0.5 to 3.5 tons per square foot (tsf). Therefore, the deposits exhibited a medium to very stiff (cohesive) consistency or a very loose to loose (non-cohesive) consistency. Low-consistency deposits were typically encountered above a depth of 12 feet below the existing ground surface.

The natural moisture contents of selected samples of the deposits ranged from 22% to 34%. A tested sample of the deposits exhibited a moderate degree of plasticity with a liquid limit (LL) value of 40 and a plasticity index (PI) value of 25. The tested sample contained 43.7% fine-grained (silt and clay size) particles. Based on USCS classification guidelines, the tested soil sample classified as clayey sand (SC).

5.4 Groundwater

Groundwater was measured in the borings at the time of drilling. Both borings encountered groundwater, boring B-1 at a depth of 9 feet below the ground surface, and boring B-2 at a depth of 21 feet below the ground surface. Additionally, a piezometer was installed in boring B-1 to obtain a delayed measurement. Groundwater was encountered in the piezometer in boring B-1 at a depth of ±4½ feet below the ground surface 37 days after drilling. Boring B-2 was backfilled upon completion, while boring B-1 left open due to the installed piezometer.

We note that perched groundwater is often present within a layered subsurface profile such as that present at the subject site. Surface water can percolate through the upper, porous fill soils and become trapped over less permeable deposits.

The soils at the site contain a significant amount of fine-grained particles. The fine-grained soils exhibit a relatively low permeability. Therefore, long-term monitoring over several seasons would be required to fully evaluate the stabilized depth to groundwater. Groundwater depth is highly variable and will often fluctuate due to seasonal variations in precipitation.

6.0 EARTHWORK CONSIDERATIONS

Based on review of available plans (*Filtration System Detail Section Views*; sheet C-414; dated May 2024), we understand the floor elevation of proposed basin bottom will be EL 355.00'. The existing grade in the vicinity of the basin is ±EL 356.50'. Therefore, accounting for the thickness of the basin slab, earthwork to facilitate construction of the filter is expected to include cuts on the order of 2 to 3 feet. Deeper excavations may be required for installation of utility piping.

We are providing the following earthwork-related recommendations based on the provided grading and site layout information available at the time of report preparation. If significant changes are made to the development plans or if the assumed grading and site layout information is altered, CDG should be allowed to review our geotechnical recommendations in light of the changes to determine if additional testing and revised conclusions are needed. Following are our earthwork-related recommendations.

6.1 Subgrade Preparation

Prior to the start of excavation and fill placement, the proposed development area should be cleared of vegetation, topsoil, rootmat, and all organic materials. Topsoil was initially encountered at the boring locations and was approximately 6 inches in thickness. Additionally, the site should be cleared of any existing improvements. Demolition should include all below-ground elements such as buried foundations and stem walls, basements, slabs, septic systems, wells, and utility lines. All debris including buried trash, organics, rubble, and other deleterious materials should be completely removed. Soils immediately underlying existing pavements, slabs, and other ground supported structures often exhibit a low-consistency. All soft soils exposed during demolition should be removed. Excavations resulting from site clearing should be backfilled in a controlled manner with structural fill.

The borings encountered existing fill and low-consistency deposits to a depth of approximately 12½ feet below the existing ground surface in both borings. Structures supported on low-consistency soils are likely to experience differential settlement and resultant distress. Typical distress consists of cracking in rigid structures such as concrete and masonry elements, and misalignment of utility connections, windows and doors. Therefore, it is our opinion that the on-site soils, in their current condition, are not suitable for support of the proposed structure.

Due to the depth of the unsuitable soils and presence of shallow groundwater, mass over-excavation of unsuitable soils to mitigate potential settlement/consolidation does not appear to be a cost-effective alternative for support of the tertiary filter. Therefore, we recommend that a rammed aggregate pier system be utilized to improve ground support conditions at the filter location. Installation of the pier system results in a reinforced, composite subgrade that increases the allowable bearing pressure and reduces estimated settlements under vertical loading.

Rammed aggregate pier systems are typically a proprietary design-build technology. The design-build company will select the most appropriate system for construction, specify spacings, quantities, and lengths based on soil conditions, foundation loads, and performance criteria. The design-build contractor will produce engineer-sealed shop drawings, calculations, an installation schedule, and quality control package which will then be installed by a licensed contractor.

There are multiple rammed aggregate pier systems available with specialty tooling and installation techniques adapted to improve a wide variety of soil conditions. For this site, we anticipate a displacement-style rammed aggregate pier system will be required due to the presence of groundwater within the anticipated zone of improvement. Displacement-style systems are installed by driving a hollow mandrel into the ground, displacing the soil laterally and forming a cavity. The mandrel itself serves at a temporary casing during installation of the rammed aggregate pier. After the mandrel has been advanced to the proposed treatment depth, the tooling is raised and lowered in a specified stroke pattern. During this process, aggregate is funneled from a top mounted hopper, down through the hollow mandrel and into a widened compaction chamber where it is forced into the soil at the bottom of the tooling. The installation process results in vertically compacted lifts, similar to the drilled aggregate pier systems. A drilled rammed aggregate pier system may be more appropriate for an improved zone that can be installed above the groundwater table.

Piers are expected to be installed after final subgrade elevation is established in the building pad. Following ground improvements with the pier system, shallow foundations are typically designed for increased allowable bearing pressures ranging from 4,000 to 8,000 psf. Settlement tolerances are typically specified as being limited to 1 inch for the total settlement case and ½ inch for the differential settlement case. Specific foundation recommendations for this site are discussed in **Section 7** of this report.

Installation of the rammed aggregate pier system should be observed by a representative of CDG. Additionally, the pier contractor typically engages a 3rd party to keep records of the date, depth of penetration, bearing material, and additional pertinent data regarding each individual rammed aggregate pier. The effective use of rammed aggregate piers to improve bearing conditions is highly dependent on proper construction techniques. Therefore, it will be critical that CDG be on-site during installation to ensure the piers conform to the design requirements.

6.2 Water Control

Groundwater was encountered at a depth of 21 feet in boring B-2 at the time of the subsurface exploration. However, groundwater was encountered at 4½ feet in the piezometer at boring location B-1. Therefore, it is likely that water seepage will be encountered during earthwork operations, particularly during excavation of deeper utility trenches and during rammed aggregate pier installation.

The volume of water encountered during grading is expected to vary based on recent precipitation levels. Therefore, the extent and method of dewatering will depend on the time of year earthwork is performed and can be determined in the field on a case-by-case basis. In general, water seepage present in excavations should be collected and removed from the site in a controlled manner with temporary sump pits and pumps or drainage ditches.

Permanent drains will be required in areas exhibiting continual seepage such as in natural drainage swales and where springs are encountered. The drain will serve to collect and remove water that continues to seep into the area and reduce the potential of water infiltrating the adjacent subgrade soils.

A typical trench drain should consist of a geosynthetic-lined trench, approximately 18 to 30 inches in width. The depth of the drain generally ranges from 24 to 36 inches and is determined based on field conditions. The geosynthetic should be a non-woven fabric designed for filtration (TerraTex SD or similar). A perforated drainpipe should be installed and the trench backfilled with free draining (less than 5% passing the #200 sieve), open-graded coarse aggregate (such as ASTM C-33 #57). The geotextile is then wrapped over the aggregate to completely enclose the drain.

6.3 Excavation Considerations

Maximum excavation depths of approximately 3 feet below the existing ground surface are expected to construct the filter basin. Deeper excavations may be required for utility trenching. The borings at the site encountered existing fill and coastal plain deposits. Groundwater was encountered in the piezometer at B-1 at 4½ feet. The existing fill and residual soils can typically be excavated during mass earthwork operations using conventional earthmoving equipment (e.g. hydraulic excavator or large dozer) in good working order.

The soils encountered at the boring locations contained significant fractions of coarse-grained soils. Additionally, springs are frequently encountered in the geologic formation underlying the site. Due to the presence of non-cohesive soils and the potential for groundwater seepage, the sides of excavations made at the site are expected to be unstable and likely to cave. Therefore, benching, sloping, temporary bracing or other appropriate measures will be necessary when making excavations.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. This report is not intended to address safety issues related to excavations. Job site safety and conformance to applicable codes and guidelines is solely the responsibility of the contractor.

6.4 Fill Placement

All material used as structural fill should be relatively free of organics and other deleterious materials. Soil fill should exhibit a Liquid Limit less than 50, a Plasticity Index less than 25, and a maximum dry density of at least 100 pcf. Soil fill should contain no more than 30% rock, and individual rock fragments in the fill should be less than 3 inches in largest dimension. Soil fill must be placed in an environment free of excess water. Therefore, free draining (<5% passing #200 sieve), coarse granular material (such as ASTM C-33 #57 crushed aggregate) should be used as the initial lift(s) of fill in areas containing water seepage. The aggregate fill should extend to a level above any water seepage in the excavation.

Fill should be placed in lifts not exceeding eight inches in loose measure. Individual lifts of fill should be moisture conditioned and compacted to a minimum of 98% of the Standard Proctor (ASTM D-698) maximum dry density within ±2% of the optimum moisture content. Soil may require wetting or drying to achieve proper compaction. Thinner lifts and manually operated equipment will be required to compact soils in limited access areas (e.g. around manholes, inlets and utility trenches).

Soil compaction testing should be performed during fill placement. Testing will give an indication of the contractor's performance with regard to soil density and moisture content requirements established in the project specifications. Compaction testing should be performed at random locations on each lift of fill placed to provide statistically relevant testing data. The frequency of density testing should be at least one test per lift for every 2,500 square feet of fill. Each lift of fill placed in utility trenches should be tested on 50-foot centers. A minimum of 3 tests should be performed on all fill lifts.

6.5 Use of On-Site Soils as Structural Fill

Site grading and subgrade preparation are expected to include excavation of existing fill and coastal plain deposits. The borings and laboratory testing data indicate that the on-site soils are typically suitable for reuse. However, it will be necessary to carefully screen the existing fill materials for debris or organics prior to reuse.

We note that tested on-site soil samples exhibited natural moisture contents ranging from 4% to 22%. Therefore, portions of the on-site soils are expected to be ±10% wet or dry of their optimum moisture content. If the on-site soils are to be reused as newly placed fill, the contractor should be prepared to moisture condition (dry or moisten) the soils, as necessary.

The contractor should expect to spend significant time reconditioning the existing soils if they are to be reused as structural fill. Due to the fine-grained particles in the soils, drying may require repeated disking and turning of the soil over several days of dry weather and/or use of drying agents such as fly ash or lime. The soils may require blending with water during the drier times of the year.

6.6 Protection of the On-Site Soils

Tested, on-site soils contained a significant amount (up to 43.7%) of fine-grained, silt and clay particles. Silt and clay tend to lose strength when exposed to excess moisture. Additionally, fine-grained soil can become soft and disturbed due to repeated trafficking and twisting or turning of wheeled construction equipment. Therefore, the on-site soils should be protected from surface water and construction disturbance.

Construction traffic should be controlled and routed so as to limit disturbance to the subgrade. Ponded water should not be allowed to remain on the soils and the site should be sloped to drain. Additionally, it will be important that surface water from on and off the site be intercepted and diverted away from the proposed development. Installation of temporary construction ditches may be necessary to control the flow of surface water so that construction operations can be performed in a relatively dry environment. Soils that become too wet or are disturbed should be moisture conditioned and re-compacted or removed and replaced with structural fill.

7.0 FOUNDATION RECOMMENDATIONS

Ground pressures exerted by the tertiary filter were assumed to be on the order of 2,000 psf. As noted previously, ground improvement using rammed aggregate piers is expected to be performed at the proposed filter location after final subgrade elevation is established. **It will be critical that the piers be properly designed by a design-build contractor, properly installed by a licensed contractor, and observed by CDG during installation.** Following proper installation of a rammed aggregate pier system, it is our opinion that spread footings are an appropriate alternative for foundation support of the proposed filter.

Following subgrade preparation and installation of the rammed aggregate pier system in proposed basin areas, foundations will bear on an improved, composite subgrade. The following design values should be utilized for foundation design.

Table 7.1 – Summary of Foundation Design Values

Improvement Method	Bearing Capacity	Coefficient of Friction
Rammed Aggregate Pier System	4,000 psf	0.35

Continuous and column footings should have minimum widths of 18 and 24 inches, respectively. Footings should extend to a minimum depth of 24 inches below the lowest adjacent final subgrade elevation to provide confinement for the bearing materials.

Total and differential settlements for foundations are expected to be less than 1 inch and ½ inch, respectively. Foundations should be structurally isolated from ground-supported slabs to allow for differential movement associated with variable loading conditions. Alternatively, slabs should be jointed to prevent uncontrolled cracking at the interface with foundations. Foundations supported on the pier improved subgrade should be isolated from those supported on the newly compacted fill.

Excavation for foundations often results in loosened or disturbed soils at the bearing elevation. Therefore, the bottom of footing trenches should be thoroughly compacted with a piston tamp following excavation. As previously described, water seepage may be encountered when making foundation excavations. Foundation concrete must be placed in a relatively dry excavation; therefore, temporary dewatering may be required.

A representative of CDG should observe all foundation excavations prior to concrete placement to determine if the exposed materials conform to the design requirements. Should the engineer identify isolated zones of unsuitable material present at the proposed bearing elevation, the excavation should be extended to a suitable bearing stratum. Excavations may be returned to the original planned bearing elevation with lean concrete.

Foundation bearing materials judged acceptable by the Engineer should be protected from disturbance, freezing, and excessive wetting or drying. Therefore, the footing should be constructed the same day as the excavation is made and evaluated by the Engineer. If the contractor's schedule requires a delay between excavation and foundation construction, the bearing materials should be protected with a thin seal of lean concrete.

Following construction, the foundations and underlying soils should be isolated from sources of excess water. Grades adjacent to the structures should be adjusted so that surface water flows away from the foundations. In no case should water be allowed to pond over newly constructed footings. Roof drains and downspouts should be directed away from the foundations. Additionally, soils adjacent to foundations should consist of properly compacted, structural fill to minimize water infiltration.

8.0 SLAB-ON-GRADE SUPPORT

As outlined in **Section 6.1** of this report, existing fill and low-consistency soils will be improved with rammed aggregate piers. Provided the subgrade is prepared in accordance with our recommendations, the floor slabs can be supported on newly placed, structural fill compacted to the project requirements or improved in situ soils. Ground supported slabs may be designed based on a modulus of subgrade reaction of 150 pci. A higher modulus provided by the design-build contractor may be possible for slabs supported on soils improved with aggregate piers.

The on-site soils contain fine-grained particles and may be sensitive to changes in moisture content. Soils that are wet and disturbed will lose strength and become unsuitable for slab support. Therefore, the contractor should exercise care when preparing the subgrade. Soils should be protected from disturbance caused by construction traffic. Water should not be allowed to pond on the subgrade nor should the soils be allowed to become excessively dry.

Once final subgrade elevation is established in the floor slab area, the exposed soils should be evaluated by a representative of CDG. Proofrolling with a loaded dump truck should be performed to compact the upper soils and identify areas of instability. Unsuitable material should be moisture conditioned and recompacted or removed and replaced with compacted, structural fill. Should the contractor's schedule delay floor slab construction after preparation of a suitable subgrade, the soils should be reevaluated immediately prior to concrete placement. Drying or wetting and recompaction of the soils will likely be required.

To reduce the potential for water migration through the floor slab, ground-supported slabs should be underlain by a capillary break consisting of a minimum of 4 inches of compacted, clean (<5% passing the #200 sieve), free-draining, granular material (such as ASTM C-33 #57 crushed aggregate). Depending on the type of floor coverings to be used, the owner may also elect to install a vapor barrier typically consisting of 6-mil polyethylene sheeting. The sheeting will reduce the infiltration of water vapor through the slab and the potential for damage to floor coverings. However, we note that the use of a vapor barrier will increase the potential for plastic shrinkage cracking during curing of the concrete slab.

9.0 CONSTRUCTION PHASE SERVICES

We recommend that CDG be retained to provide observation and testing services during the construction phase of the project. Construction phase services typically include testing of materials such as soils and compacted fill and structural concrete. Additionally, engineering consultation and testing related to foundation support are recommended.

A comprehensive testing program by the Geotechnical Engineer of Record is an essential element of the geotechnical evaluation for the project. Design assumptions were made based on widely spaced borings. Therefore, variations in soil properties should be expected and may only become apparent during construction. Testing and observation by the engineer of record is especially important during the earthwork and foundation phases of construction due to the high degree of variation in subsurface conditions typically present on a site in general, and due the existing fill and low-consistency deposits present on this site in particular.

CDG cannot accept responsibility for the interpretation of the recommendations contained in this report nor for the application of the recommendations during construction of the project if not retained to provide a complete scope of construction observation and materials testing services.

10.0 GENERAL REMARKS AND CLOSING

This report has been prepared for the exclusive use of the City of Troy for specific application to the **Walnut Creek WWTP Tertiary Filter Equipment Upgrade** project in Troy, Alabama and is not transferable to a third party. The recommendations in this report are intended for use on the stated project and should not be used for other purposes. It will be important for the geotechnical Engineer of Record to review the final project plans and specifications to provide the appropriate interpretation of the recommendations contained in this report.

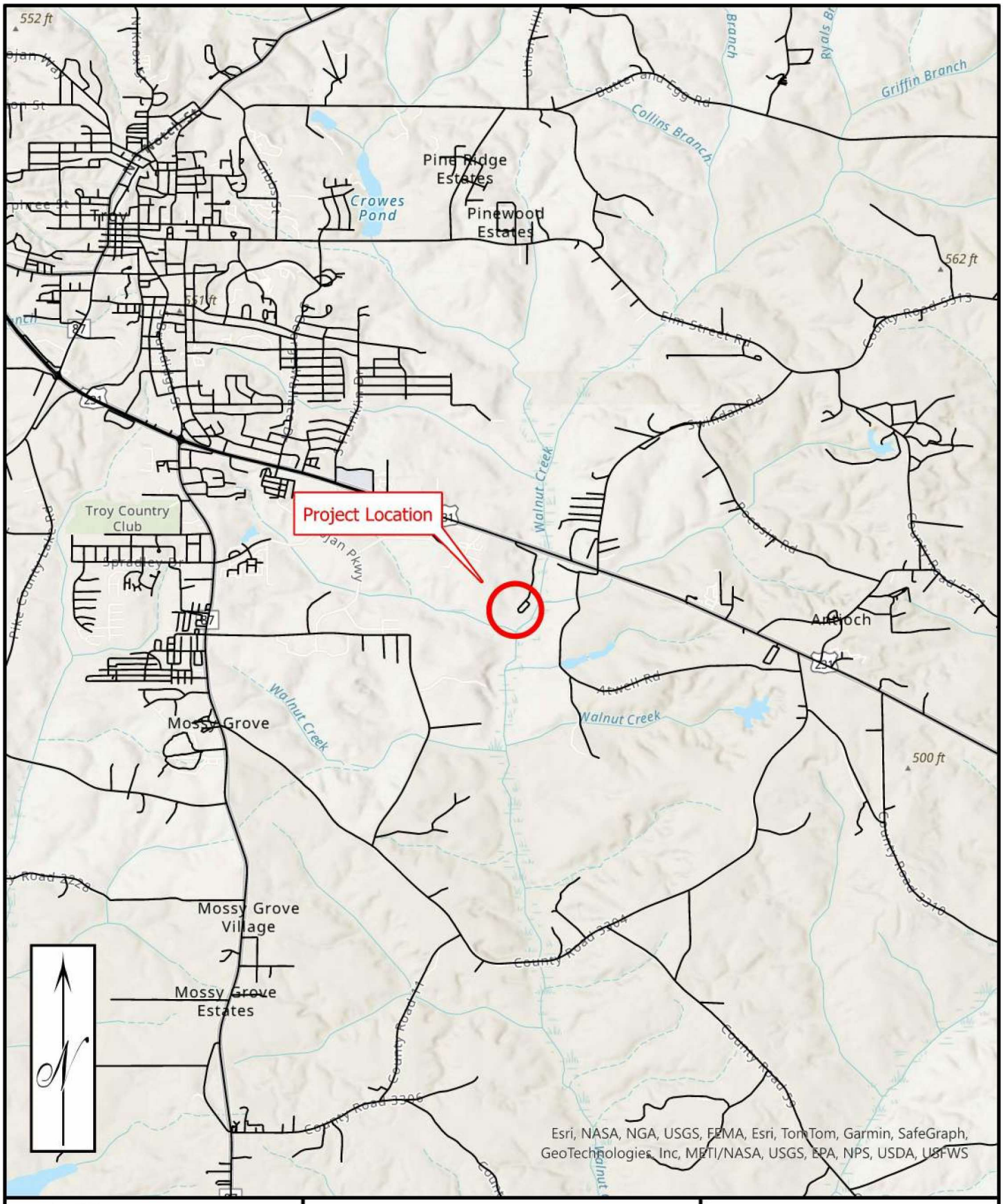
The conclusions, analyses, and recommendations presented in this report are based upon currently accepted engineering principles, practices, and existing testing standards in the area where the services were provided. No other warranty, expressed or implied, is made.

The recommendations in this report were developed based on our understanding of the proposed construction and from the limited information obtained from the subsurface exploration and laboratory testing programs. If significant changes are made in the scope of the project, CDG should be allowed to review our recommendations in light of the changes to determine if additional testing and revised conclusions are needed.

APPENDIX A

Project Maps

cdge.com

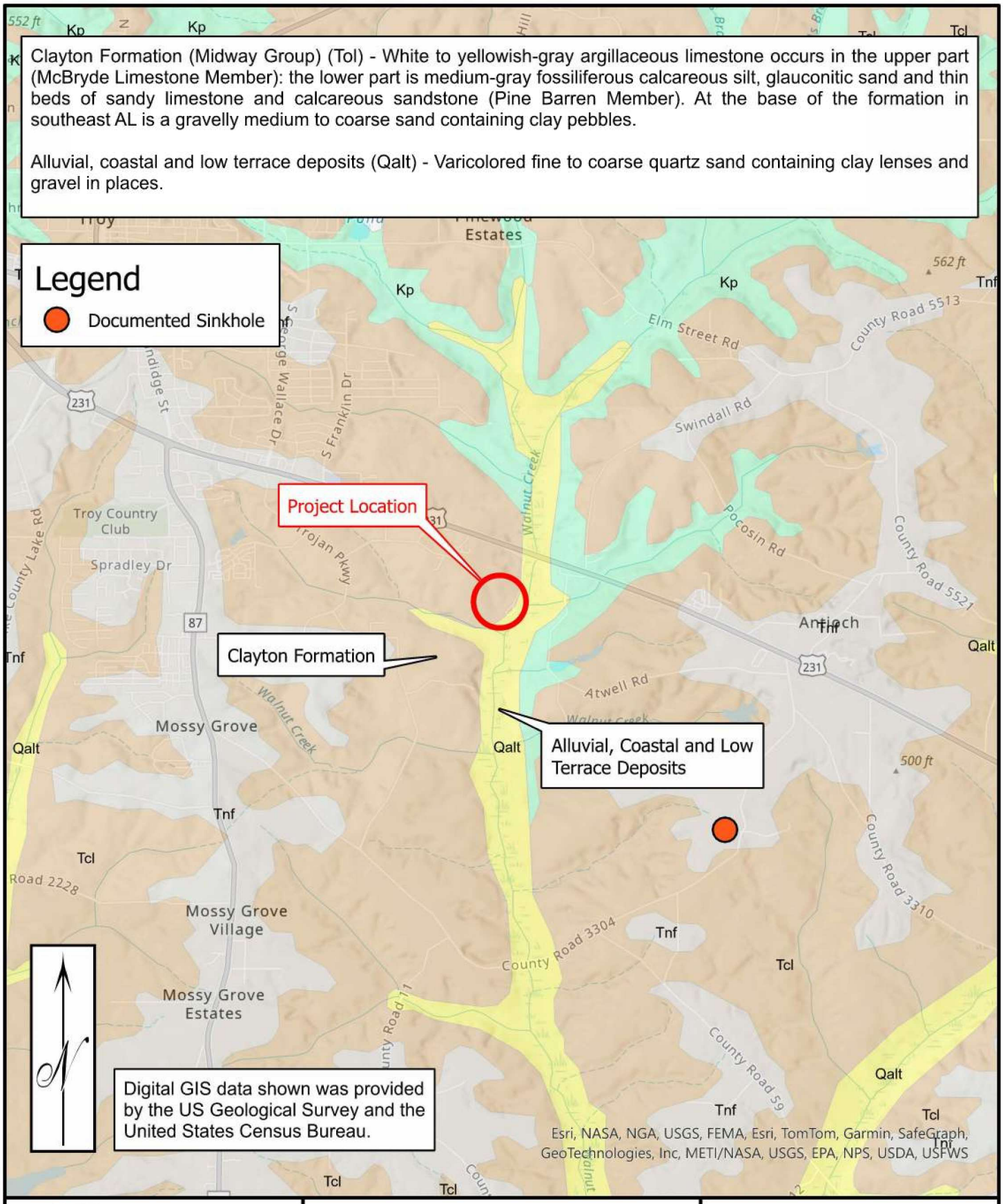


CDG

Site Vicinity Map

Drawn By: JO	Scale: 1 in = 1 mi	Date: 9/19/2024

Walnut Creek WWTP Tertiary Filtration Equipment Upgrade
Pike County, Alabama
CDG Project No. R021022458



CDG

Site Geology & Documented Sinkhole Plan

Drawn By: JO	Scale: 1 in = 1 mi	Date: 9/19/2024

Walnut Creek WWTP Tertiary Filtration Equipment Upgrade
Pike County, Alabama
CDG Project No. R021022458

APPENDIX B

Boring Location Plan

cdge.com

CDG
Engineering Environmental Answers

Boring Location Plan

Drawn By: TL	Scale: N/A	Date: 7/8/2024

Walnut Creek WWTP Tertiary Filtration Equipment Upgrade
Pike County, Alabama
CDG Project No: R021022458

APPENDIX C

Boring Logs

cdge.com

Boring ID: B-1

Walnut Creek WWTP Tertiary Filtration Equipment Upgrade

Project Number: R021021494	Ground Elevation:	Method: Geoprobe 3100GT
Project Location: Troy, Alabama	Latitude: 31.76710	Logged By: T. Griffin
Date Started: 07-09-2024	Longitude: -85.92711	Hammer Efficiency:
Date Completed: 08-22-2024	Coordinate System: Geographic	Hammer Type: Automatic

Depth (feet)	Piezometer	Elev. (ft) / Depth (ft)	Material Description and Classification	Graphic Log	Standard Penetration Test (SPT)	N-Value	Sampler	RQD / Rec: RQD cr (%)	RQD / Rec: TCR (%)	Atterberg Limits: LL (%)	Atterberg Limits: PI (%)	Moisture (%)	Fines (%)	qu (tsf)	Comments / Additional Notes
		0	±6 inches of topsoil encountered at ground surface.												
0	22 Aug 2024	0	(Fill) Medium dense, brown, silty, fine to medium SAND with gravel		10-12-11	23						8	20.1		AASHTO: A-2-4 USCS: SM Non-plastic
1															
2															
3		-3.5													
4		3.5	...loose, with large rock fragments		3-4-3	7						4			
5															
6		-6													
7		6	(Coastal Plain Deposits) Loose, gray, clayey, fine SAND		3-3-3	6									
8		-8.5													
9		8.5	...very loose, gray and tan												
10					WOH					40	25	22	43.7		AASHTO: A-6 USCS: SC WOH = Weight of Hammer
11															
12		-12.25													
13		12.25	Very stiff, gray, sandy SILT												
14															
15					6-8-10	18						24		3.0	
16															
17		-17.25													
18		17.25	...dark gray, with mica												
19															
20					13-10-12	22						34		3.0	
21															
22		-22.25													
23		22.25	...brown and gray												
24															
25					6-13-15	28								3.5	
26															

RSLog / CDG Standard Boring Log - Unknown Hammer Efficiency / cdg_inc. / admin / September 19, 2024 07:31 AM

Boring ID: B-1

Walnut Creek WWTP Tertiary Filtration Equipment Upgrade

Project Number: R021021494	Ground Elevation:	Method: Geoprobe 3100GT
Project Location: Troy, Alabama	Latitude: 31.76710	Logged By: T. Griffin
Date Started: 07-09-2024	Longitude: -85.92711	Hammer Efficiency:
Date Completed: 08-22-2024	Coordinate System: Geographic	Hammer Type: Automatic

Depth (feet)	Piezometer	Elev. (ft) / Depth (ft)	Material Description and Classification	Graphic Log	Standard Penetration Test (SPT)	N-Value	Sampler	RQD / Rec: RQD cr (%)	RQD / Rec: TCR (%)	Atterberg Limits: LL (%)	Atterberg Limits: PI (%)	Moisture (%)	Fines (%)	qu (tsf)	Comments / Additional Notes
26			*(continued)*												
27		-27 / 27	...brown and gray ...gray												
28															
29					12-12-18	30								3.5	
30		-30 / 30	Boring terminated at a depth of 30 (ft).												
31															
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Boring ID: B-2

Walnut Creek WWTP Tertiary Filtration Equipment Upgrade

Project Number: R021021494	Ground Elevation:	Method: Geoprobe 3100GT
Project Location: Troy, Alabama	Latitude: 31.76719	Logged By: T. Griffin
Date Started: 07-09-2024	Longitude: -85.92706	Hammer Efficiency:
Date Completed: 07-09-2024	Coordinate System: Geographic	Hammer Type: Automatic

Depth (feet)	Piezometer	Elev. (ft) / Depth (ft)	Material Description and Classification	Graphic Log	Standard Penetration Test (SPT)	N-Value	Sampler	RQD / Rec: RQD cr (%)	RQD / Rec: TCR (%)	Atterberg Limits: LL (%)	Atterberg Limits: PI (%)	Moisture (%)	Fines (%)	qu (tsf)	Comments / Additional Notes
		0	±6 inches of topsoil encountered at ground surface.												
0	No Data	0	(Fill) Medium dense, brown, silty, fine to medium SAND		7-8-8	16									Once groundwater was encountered, the borehole filled with water to 1' below ground surface before being backfilled.
1															
2															
3		-3.5 / 3.5	(Coastal Plain Deposits)												
4					WOH										No recovery WOH = Weight of Hammer
5															
6		-6 / 6	Medium, gray, fine sandy CLAY		3-3-4	7									
7															
8		-8.5 / 8.5	...gray and tan		0-3-3	6								0.5	
9															
10															
11															
12		-12.25 / 12.25	Very stiff, gray, sandy SILT		5-8-10	18								2.5	
13															
14															
15															
16															
17		-17.25 / 17.25	...dark gray, with mica		6-10-18	28									
18															
19															
20															
21	09 Jul 2024														
22		-22.25 / 22.25	...tan												
23					8-17-15	32								3.5	
24															
25															
26															

RSLog / CDG Standard Boring Log - Unknown Hammer Efficiency / cdg_inc. / admin / September 19, 2024 07:31 AM

Boring ID: B-2

Walnut Creek WWTP Tertiary Filtration Equipment Upgrade

Project Number: R021021494	Ground Elevation:	Method: Geoprobe 3100GT
Project Location: Troy, Alabama	Latitude: 31.76719	Logged By: T. Griffin
Date Started: 07-09-2024	Longitude: -85.92706	Hammer Efficiency:
Date Completed: 07-09-2024	Coordinate System: Geographic	Hammer Type: Automatic

Depth (feet)	Piezometer	Elev. (ft) / Depth (ft)	Material Description and Classification	Graphic Log	Standard Penetration Test (SPT)	N-Value	Sampler	RQD / Rec: RQD cr (%)	RQD / Rec: TCR (%)	Atterberg Limits: LL (%)	Atterberg Limits: PI (%)	Moisture (%)	Fines (%)	qu (tsf)	Comments / Additional Notes
26			*(continued)*												
27		-27 / 27	...tan ...gray												
28															
29					5-10-10	20									
30		-30 / 30	Boring terminated at a depth of 30 (ft).												
31															
32															
33															
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51															
52															

RSLog / CDG Standard Boring Log - Unknown Hammer Efficiency / cdg_inc. / admin / September 19, 2024 07:31 AM

APPENDIX D

Laboratory Test Results

cdge.com

Soil Classification Results

Dothan
1962 West Main Street
Dothan, AL 36301
Phone: 334-677-9431

Client:

City of Troy
P.O. Box 549
Troy, AL 36081

Project:

R021022458
Troy Walnut Creek WWTP Lead Rem. Upgrade
588 County Road 3355
Troy, AL 36081

Sample and Test Information

Boring No. / Sample #: B-1 / 6988

Location Details: B-1 @ 1.5-3'

Sample Depth (ft.): 1.5-3

Sample Description:
Brown, silty, fine to medium SAND with gravel

Date Sampled: 07/17/2024 **Date Tested:** 08/14/2024

Completed By: John Rhodus **Date Issued:** 08/15/2024

Report of Atterberg Limits (ASTM D4318)

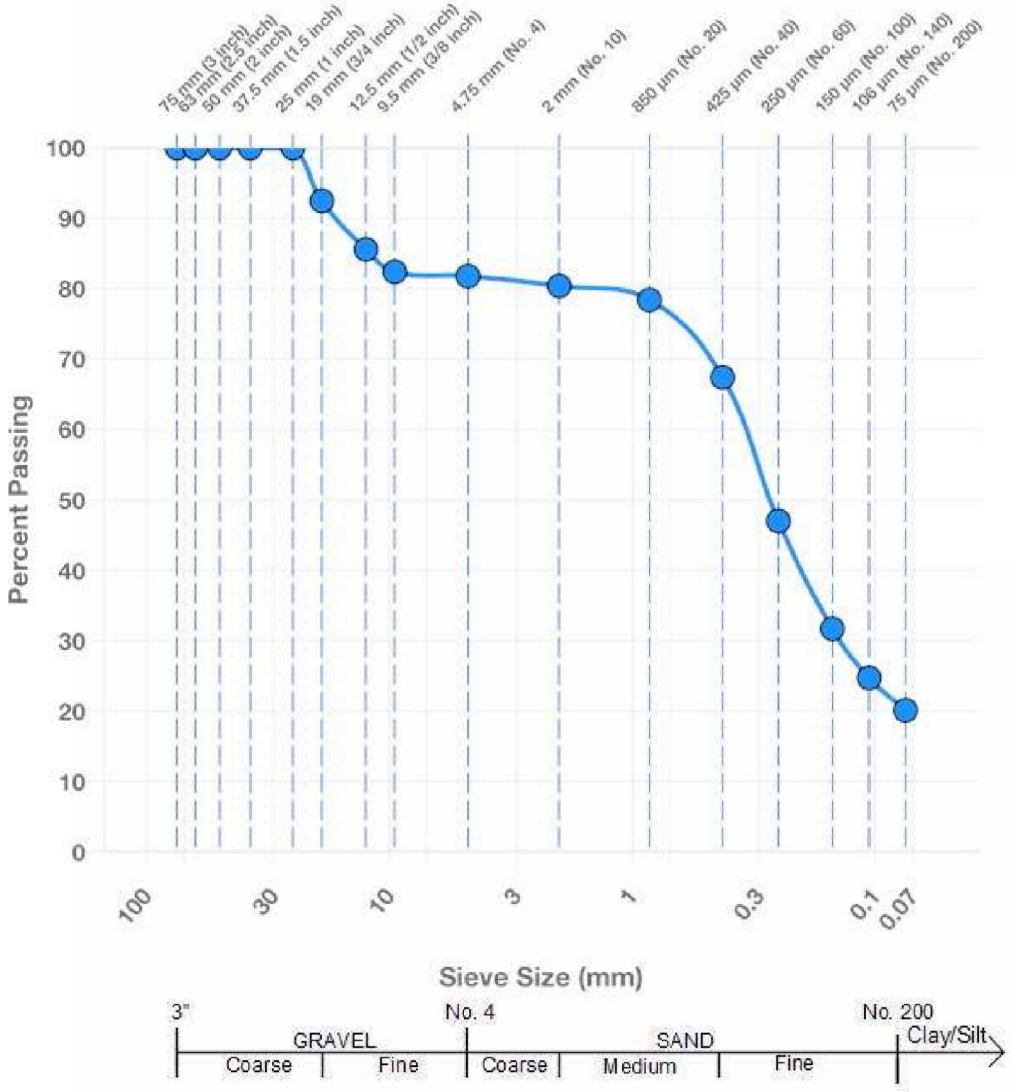
Liquid Limit (LL): NP
Plastic Limit (PL): NP
Plasticity Index (PI): NP

Classifications
AASHTO : A-2-4
USCS: SM

Report of Sieve Analysis (ASTM D6913)

Percent Gravel: 18.2
Percent Sand: 61.7
Percent Clay/Silt: 20.1

Soak Duration: 24 hours



Soil Classification Results

Dothan
1962 West Main Street
Dothan, AL 36301
Phone: 334-677-9431

Client:
City of Troy
P.O. Box 549
Troy, AL 36081

Project:
R021022458
Troy Walnut Creek WWTP Lead Rem. Upgrade
588 County Road 3355
Troy, AL 36081

Sample and Test Information

Boring No. / Sample #: B-1 / 6991

Location Details: B-1 @ 9-10.5'

Sample Depth (ft.): 9-10.5

Sample Description: Gray and tan, clayey, fine SAND

Date Sampled: 07/17/2024 **Date Tested:** 08/14/2024

Completed By: John Rhodus **Date Issued:** 08/15/2024

Report of Atterberg Limits (ASTM D4318)

Liquid Limit (LL): 40

Plastic Limit (PL): 15

Plasticity Index (PI): 25

Classifications

AASHTO : A-6

USCS: SC

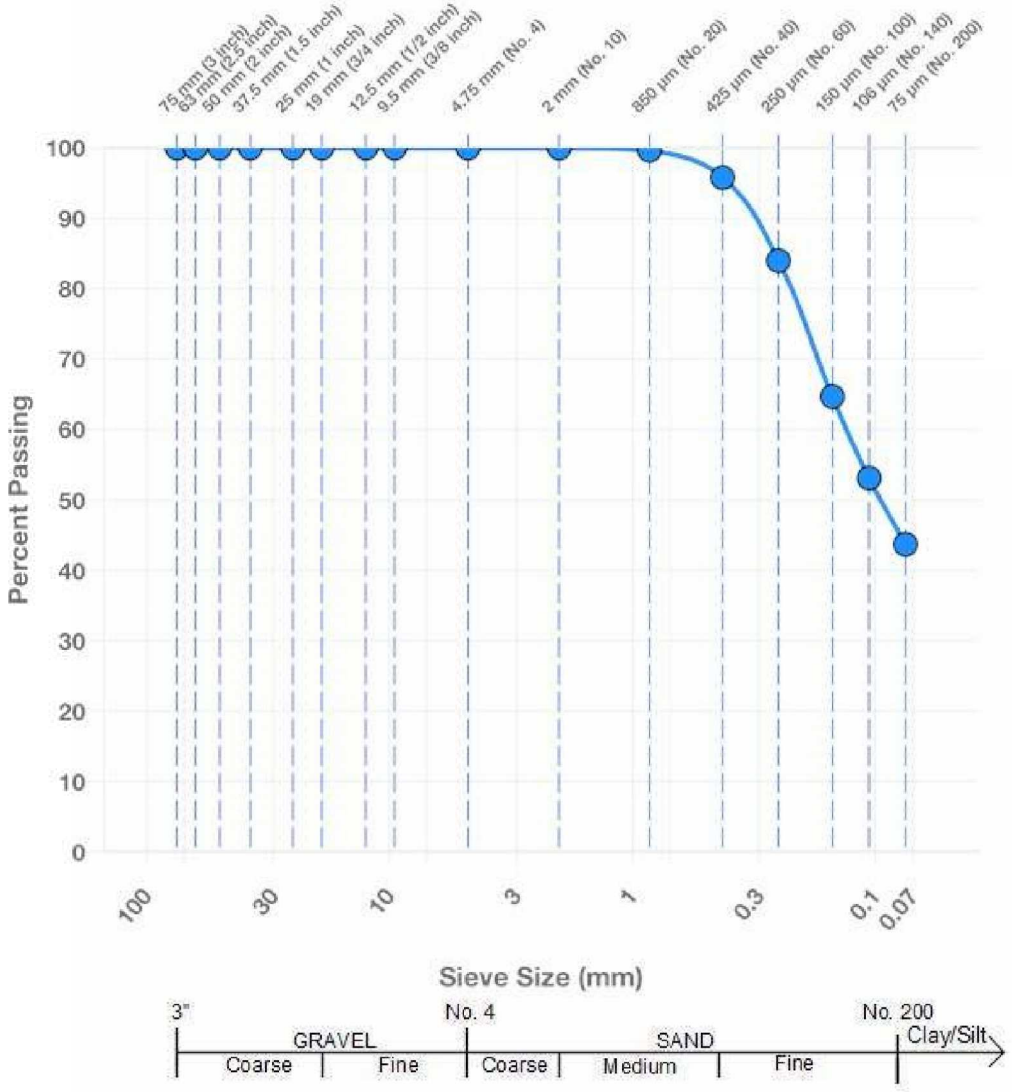
Report of Sieve Analysis (ASTM D6913)

Percent Gravel: 0.0

Percent Sand: 56.3

Percent Clay/Silt: 43.7

Soak Duration: 24 hours



Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

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