



**City of Havelock**  
Havelock, North Carolina

## **Project Manual**

# **MacDonald Downs Pump Station**

Hazen Project No. 30906-006

September 2017

**Issued for Bid**

Hazen and Sawyer  
4011 WestChase Blvd., Suite 500  
Raleigh, NC 27607  
NC License No. C-0381

**Hazen**





Nichole Johnson, PE  
Associate

## Project Manual

### MacDonald Downs Pump Station

Havelock, North Carolina

Prepared for:

City of Havelock, North Carolina

Prepared by:

Hazen and Sawyer

4011 WestChase Blvd., Suite 500

Raleigh, North Carolina 27607

Tel 919 755 8603

NC Engineering License # C-0381

Hazen Job No.:

30906-006

Date:

September 2017

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**FINAL SPECIFICATIONS  
ISSUED FOR BID**



**CITY OF HAVELOCK, NORTH CAROLINA  
MACDONALD DOWNS PUMP STATION**

SECTION 00003

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SECTION 00009

**INVITATION FOR BIDS**

BY THE CITY OF HAVELOCK, N.C. FOR THE  
MACDONALD DOWNS PUMP STATION

The City of Havelock will open sealed Bids at 2:00 p.m., local time, on October 19, 2017 at City Hall located at One Governmental Ave. Havelock, NC 28532 for the following Project:

Construction of the MacDonald Downs Pump Station.

A pre-bid meeting will be held at 11:00 am on October 4, 2017 at City Hall, One Governmental Ave. Havelock, NC 28532.

Plans and Specifications may be examined at the following locations:

Dodge Data and Analytics  
830 Third Avenue, 6<sup>th</sup> Floor  
New York, NY 10022  
Email: support@construction.com

Construction Connect  
30 Technology Parkway South  
Peachtree Corners, GA 30092

Hazen and Sawyer  
4011 WestChase Boulevard  
Suite 500  
Raleigh, North Carolina 27607

Each Bidder must show evidence that it is licensed under Chapter 87 of the N.C. General Statutes.

The Board of Commissioners of the City of Havelock reserves the right to reject any or all proposals.

Contract Documents may be purchased from Hazen and Sawyer for \$75.00, by a check payable to Hazen and Sawyer. To obtain Contract Documents, contact Marcus Lanier at (919) 833-7152 or by email at mlanier@hazenandsawyer.com.

DATE: September 19, 2017



## SECTION 00100

### INSTRUCTIONS TO BIDDERS

#### 1. DEFINED TERMS

Terms used in these Instructions to Bidders which are defined in the Standard General Conditions of the Construction Contract, NSPE Document 1910-8 (1996 edition) shall have the meanings assigned to them in the General Conditions as modified, changed, added to or deleted by the Supplementary Conditions.

#### 2. QUALIFICATIONS OF BIDDERS

To demonstrate his qualifications for the Project, each Bidder shall submit with his Proposal satisfactory proof of his qualifications to perform in a satisfactory manner and within the time specified in the Proposal, all of the work covered by the Contract Documents. Bidder shall submit, among other items, information and evidence with respect to the following:

- 2.1 That he has a well-trained and competent organization which has done work of similar character and value;
- 2.2 That he will have availability to do the work at the proper time or times, adequate equipment and facilities listing such equipment and facilities in such detail that they can be quickly and accurately checked;
- 2.3 That he has ample repair parts and supplies to maintain all equipment and facilities properly and with a minimum of delay;
- 2.4 If the Bidder is a corporation, the names of all corporate officers and the name of the executive who will give his personal attention to the work;
- 2.5 Detailed financial information relating to the resources of the Bidder.
- 2.6 The Contractor shall perform work amounting to at least 50% of the Contract, using **his own personnel and equipment (owned or rented)**. No portion of the Contract shall be sublet, assigned, or otherwise disposed of without with the expressed written consent of the Owner. **If the Contractor fails to demonstrate to the Owner in its Bid submittal information that he has the ability to perform the specified percentage of the Work with his own personnel and equipment, his Bid may be considered non-responsive.** The Contractor shall submit with its Bid, data supporting its ability to comply with this requirement.

Forms for submitting data and information relating to the financial responsibility of the Bidder are attached to the Proposal form and Bidders are requested to use such forms for the purpose intended. All information will be kept strictly confidential and used in determining whether the Bidder is qualified to do work set forth in the Contract Documents.

3. EXAMINATION OF CONTRACT DOCUMENTS AND SITE

- 3.1 Before submitting his Bid, each Bidder must:
- 3.1.1 examine the Contract Documents thoroughly;
  - 3.1.2 visit the site to familiarize himself with local conditions that may in any manner affect performance of the work;
  - 3.1.3 familiarize himself with federal, state, and local laws, ordinances, rules and regulations affecting performance of the work;
  - 3.1.4 carefully correlate his observations with the requirements of the Contract Documents; and
  - 3.1.5 notify Engineer of all conflicts, errors, or discrepancies in the Contract Documents.
  - 3.1.6 the site shall be inspected only in the company of an authorized representative of the Owner with appointments made through the City of Havelock.
- 3.2 Before submitting his Bid, each Bidder will, at his own expense, make such additional surveys and investigations as he may deem necessary to determine his Bid Price for performance of the work within the terms of the Contract Documents. Any Bidder desiring access to the site for the purpose of additional subsurface investigations must advise the Owner for coordination of access.
- 3.3 The submission of a Bid will constitute an incontrovertible representation by the Bidder that he has complied with every requirement of this Article 3.
- 3.4 Complete sets of Bid Documents can be obtained from the office of the Engineer as stated in the Invitation to Bid. Complete sets of Bid Documents shall be used in preparing bids and all Bidders shall be plan holders on record with the Engineer. If electronic copies of bid documents are provided they will be issued for convenience only.

4. INTERPRETATION

- 4.1 All questions about the meaning or intent of the Contract Documents shall be submitted in writing to Hazen and Sawyer P.C. at 4011 WestChase Boulevard, Suite 500, Raleigh, N.C. 27607, Attn: Nichole Johnson, PE, [njohnson@hazenandsawyer.com](mailto:njohnson@hazenandsawyer.com). Replies will be issued by Addenda, mailed or delivered to all parties recorded by the Engineer as having received the bidding documents. Questions received less than five (5) days prior to the date for opening of Bids will not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

- 4.2 Addenda, when issued, will be on file at the offices of the Owner and Engineer at least twenty-four (24) hours before Bids are opened. **It shall be the Bidder's responsibility to make inquiry as to the Addenda issued.** All such Addenda shall become part of the Contract Documents and all Bidders shall be bound by such Addenda, whether or not received by the Bidders.

5. BID SECURITY

Each Bid must be accompanied by a Bid security which shall not be less than five (5%) percent of the Bid amount. The required security must be in the form of cash, a certified or bank cashier's check on some bank or trust company insured by the Federal Deposit Insurance Corporation made payable to Owner, or a Bid Bond issued by a surety licensed to conduct business in the state where the Project is located. The Bid security of the successful Bidder will be retained until he has executed the Contract and furnished the required Contract security, whereupon it will be returned; if he fails to execute and deliver the Contract and furnish the required Contract security within fifteen (15) calendar days of the Notice to Award, Owner may annul the Notice of Award and the Bid security of the Bidder will be forfeited. The Bid security of any other Bidder whom Owner believes to have a reasonable chance of receiving the Award may be retained by Owner until the earlier of (1) the seventh day after the executed Contract is delivered by the Owner to Contractor and the required Contract security is furnished or (2) the sixty-first day after Bid opening. Bid security of other Bidders will be returned within ten (10) days of the Bid opening.

6. CONTRACT TIME

The number of days for completion of the work (the Contract Time) is set forth in the Contract. The Contractor shall commence work on the date specified in the Notice to Proceed, and he shall complete the work within the stipulated Contract time.

7. SUBCONTRACTORS

7.1 The apparent low Bidder and any other Bidder so requested shall within thirty (30) days after the Bid opening submit to the Owner an experience statement with pertinent information as to similar projects and other evidence of qualifications for each identified Subcontractor, person or organization who will furnish labor or materials including the names of equipment manufacturers. If Owner or Engineer after due investigation has reasonable objection to any proposed Subcontractor, other person or organization, he may before giving the Notice of Award request the apparent low Bidder to submit an acceptable substitute without an increase in his Bid Price. Any Subcontractor, other person or organization so listed and to whom the Owner or Engineer does not make written objection prior to the giving of the Notice of Award will be deemed acceptable to the Owner and Engineer. This does not remove responsibilities for said Subcontractor, supplier, etc., to comply with the Contract Specifications.

7.2 Contractor shall not be required to employ any Subcontractor, other person or organization against whom he has reasonable objection.

8. PROPOSAL FORM

- 8.1 Proposals shall be submitted on the Proposal Form furnished with the Contract Documents.
- 8.2 All blank spaces for Bid prices in the Proposal shall be properly completed in ink in both words and numerals. In case of conflict between the Price in words and its equivalent shown in numerals, the words will take precedence. PROPOSALS SHALL NOT BE CONDITIONAL, LIMITED OR RESTRICTED IN ANY WAY.
- 8.3 Bids by corporations must be executed in the corporate name by the president or vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown below the signature.
- 8.4 Bids by partnership must be executed in the partnership name and signed by a partner, his title must appear under his signature and the official address of the partnership must be shown below the signature. The Owner reserves the right to request submission of partnership documents to determine the authority of the partner to execute the instrument.
- 8.5 All names must be printed in ink below the signature.
- 8.6 The Bid shall contain an acknowledgement of receipt of all Addenda, the numbers of which shall be filled in on the Proposal form.
- 8.7 Enter Contractor's license number where called for in the Proposal.

9. SUBMISSION OF PROPOSALS

- 9.1 Proposals shall be submitted at the time and place indicated in the Notice to Bidders and shall be included in an opaque sealed envelope, marked with the Project title and name and address of the Bidder. Contractor's license number, and accompanied by the Bid security and other required documents. No Proposal will be considered unless filed on or before the time and at the place designated in the Notice to Bidders. Proposals received after the time set for their receipt will be returned unopened.
- 9.2 Proposals sent by mail should be registered mail. The sealed Proposal, marked as indicated above, should be enclosed in an additional sealed envelope similarly marked and addressed to:

Finance Director  
City of Havelock  
One Governmental Ave.  
Havelock, NC 28532

Mark envelope with the Project title and Contract number in the lower left-hand corner. Proposals sent by mail and arriving after the time for opening of Bids shall not be considered as valid Bids. In such instances, the Bidder shall have no claim against the Owner.

9.3 THE FOLLOWING FORMS AND DOCUMENTATION SHALL BE COMPLETELY FILLED OUT AND SUBMITTED WITH THE BIDS:

- 1) Bid Bond or other security
- 2) Equal Employment Opportunity
- 3) Affidavit of Organization and Authority and Sworn Statement
- 4) Statement of Experience of Bidder
- 5) Enter Contractor's License Number where called for in Proposal and on the outside of the sealed envelope containing the Proposal.
- 6) Photocopy of Contractor's License
- 7) Non-Collusive Affidavit
- 8) Certified list of equipment manufacturers

Failure to submit all of the above forms with the Proposal shall be just cause for rejection of the Proposal by the Owner.

9.4 Insert Special Notice: NC Sales Tax

10. MODIFICATION AND WITHDRAWAL OF PROPOSALS

- 10.1 Written or telegraphic modifications of Proposals may be accepted if received in accordance with the requirements for the submission of Proposals as provided in Article 9 above. Bidders are cautioned that if in the opinion of the Owner or the Engineer such modifications are not explicit, or are in any sense subject to misinterpretation, then the Proposal so amended or modified will be subject to rejection.
- 10.2 Any Bidder upon his properly notarized written request will be given permission to withdraw his Proposal prior to the time scheduled for the opening of Bids. At the time of opening of the Proposals, when such Proposal is included, it will be returned to the Bidder unread. Negligence on the part of the Bidder in preparing his Proposal confers no right for the withdrawal of the Proposal after it has been opened.
- 10.3 If a bidder makes a request to withdraw his Proposal following the opening of the Proposals by the Owner, the request and consideration shall comply with NCGS 143-129.1. If the end of the seventy second (72<sup>nd</sup>) hour after the Proposals are opened occurs at a time when the Owner's administrative offices are not open for business, the period for submitting the request shall be extended to the end of the next business day when the Owner's administrative offices are open.

11. OPENING OF BIDS

- 11.1 Proposals will be received and Bids publicly opened and read at the time(s) and place indicated in the Notice to Bidders.

12. BIDS TO REMAIN OPEN

All Bids shall remain open for sixty (60) days after the day of the Bid opening, but Owner may, in his sole discretion, release any Bid and return the Bid security prior to that date.

13. AWARD OF CONTRACT

13.1 Owner reserves the right to reject any and all Bids and waive any and all informalities, and the right to disregard all nonconforming or conditional Bids or counter Proposals.

13.2 In evaluating Bids, Owner shall consider the qualifications of the Bidders, whether or not the Bids comply with the prescribed requirements, and alternates and installed prices as requested in the Proposal forms. He may consider the qualifications and experience of Subcontractors and other persons and organizations (including those who are to furnish the principal items of material or equipment) proposed for those portions of the work as to which the identity of Subcontractors and other persons and organizations must be submitted, as required by Article 7. He may conduct such investigations as he deems necessary to establish the responsibility, qualifications and financial ability of the Bidders, proposed Subcontractors and other persons and organizations to do the work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time. Owner reserves the right to reject the Bid of any Bidder who does not pass any such evaluation to Owner's satisfaction.

13.3 If a Contract is to be awarded, it will be awarded to the lowest responsible Bidder whose evaluation by Owner indicates to the Owner that the Award will be in the best interest of the Project.

13.4 The Owner will give the apparent successful Bidder a Notice of Award within sixty (60) days after the day of the Bid opening. The successful Bidder shall execute and return to the Engineer the Contract within fifteen (15) calendar days of the date of Notice of Award of Contract.

13.5 In addition, the successful Bidder, within the period stipulated in Paragraph 13.4, shall procure, execute and deliver to the Owner and maintain, at his own cost and expense, a Performance Bond and a Payment Bond as specified in the Supplementary Conditions.

13.6 Failure or refusal of the Bidder whose Proposal is accepted to execute the Contract as hereinbefore provided shall constitute a breach by such Bidder of the Contract created by the acceptance of the Proposal, and in such event, the Owner at his option, may determine that such Bidder has abandoned the Contract. Thereupon such Bidder's Proposal and the acceptance thereof shall be null and void. It is understood by the Bidder, in the event of the annulment of the Award, that the amount of the cash, certified check, or Bid Bond, submitted with the Proposal shall be forfeited to the use of the Owner, not as a penalty, but as liquidated damages.



14. MEETINGS

14.1 Pre-bid Meeting

A pre-bid meeting will be held at 11:00 a.m. on October 4, 2017 at City Hall located at One Governmental Ave. Havelock, NC 28532. The meeting will be held to discuss the Project and answer pertinent questions. Representatives of the Owner and Engineer will be available to answer questions. The pre-bid meeting is not mandatory.

- END OF SECTION -



SECTION 00010

NOTICE TO BIDDERS

**CITY OF HAVELOCK, NORTH CAROLINA**

**MACDONALD DOWNS PUMP STATION RELOCATION**

Sealed Bids will be received by the City of Havelock, hereinafter called the OWNER, in the Auditorium of City Hall, One Governmental Ave. Havelock, NC 28532 until 2:00 p.m. local prevailing time on October 19, 2017.

A pre-bid meeting will be held at 11:00 am on October 4, 2017 at City Hall, One Governmental Ave. Havelock, NC 28532.

SINGLE PRIME CONTRACT: Includes furnishing and installing facilities as described under in the Contract Documents.

The foregoing description shall not be construed as a complete description of all work required.

Each Bid must be made on the blank forms provided in the bound copies of the CONTRACT DOCUMENTS and must be enclosed in a sealed envelope and addressed to the Finance Director, City of Havelock, One Governmental Ave. Havelock, NC 28532. The name and address and the NC Contractor's License Number of the Bidder must be plainly written on the outside of the envelope, and the envelope marked "Proposal for the MacDonald Downs Pump Station Relocation." No Bid shall be considered or accepted by the Owner unless at the time of its filing the same shall be accompanied by a deposit of cash, or a cashier's or a certified check drawn on a bank or trust company insured by the Federal Deposit Insurance Corporation, in an amount equal to not less than five percent (5%) of the Proposal. In lieu of making the deposit as above provided, such Bidder may file a Bid Bond executed by a corporate surety licensed under the laws of North Carolina to execute such bonds; conditioned that the surety will upon demand forthwith make the payment to the City of Havelock upon said Bond if the Bidder fails to execute the Contract in accordance with the Bid Bond. If upon acceptance of his Bid, a Bidder fails to enter into a Contract with the City of Havelock, the Bid deposit shall be forfeited to and become the property of the Owner. No Bidder may withdraw his Bid within 60 days after the date of Bid opening.

A separate performance bond and payment bond each in an amount equal to one hundred percent (100%) of the Contract price will be required. Carriers must be authorized to do business in North Carolina.

Bidders must conform with the provisions of the North Carolina Contractor's Licensing Act of 1925, as amended.

The Owner reserves the right to reject any Proposal for failure to comply with all requirements of this Notice or of any of the Contract Documents; however, it may waive any minor defects or informalities at its discretion. The Owner further reserves the right to reject any and all Proposals or to Award the contract which in its judgment is in the best interest of the Owner.

Contract Documents may be examined at the following locations:

McGraw-Hill Dodge Plan Room  
3315 Central Avenue  
Hot Springs, AR 71913  
Email: [dodgedocumentca@mhfi.com](mailto:dodgedocumentca@mhfi.com)

Construction Connect  
30 Technology Parkway South  
Peachtree Corners, GA 30092

Hazen and Sawyer  
4011 WestChase Boulevard  
Suite 500  
Raleigh, North Carolina 27607

Copies of the Contract Documents may be obtained at the office of Hazen and Sawyer located at 4011 WestChase Boulevard, Suite 500, Raleigh, North Carolina, 27607, upon payment of \$75 (non-refundable for each set of documents so obtained).

Each application must be accompanied by a check made payable to Hazen and Sawyer.

Neither the Owner nor the Engineer will be responsible for full or partial sets of Contract Documents, including any Addendum, obtained from any other source.

Bidders must certify that they do not and will not maintain or provide for their employees any facilities that are segregated on a basis of race, color, creed or national origin, and so certify with the form included in the Proposal.

City of Havelock, North Carolina (OWNER)

Dated: September 19, 2017

- END OF SECTION -

SECTION 00300

PROPOSAL

TO: City Of Havelock

FROM: BIDDER \_\_\_\_\_

ADDRESS \_\_\_\_\_  
\_\_\_\_\_

DATE OF BID \_\_\_\_\_, 20 \_\_\_\_

The undersigned hereby signifies that it is \_\_\_\_\_ (his/their) intention and purpose to enter into a formal Contract with the \_\_\_\_\_, to furnish all labor, materials, tools, equipment, apparatus, supplies, etc., required and to do all the work necessary for and because of the construction, erection, and/or installation of the proposed

MacDonald Downs Pump Station Relocation

for the City of Havelock, North Carolina \_\_\_\_\_, in accordance with the Contract Documents, including Addenda Nos. \*\* \_\_\_\_\_. There is deposited, herewith, a certified check in the amount of: \_\_\_\_\_

\_\_\_\_\_ Dollars (\$ \_\_\_\_\_), or a Bid Bond in the amount of five percent (5%) of the total aggregate amount of this Bid made payable to the Owner, the same to be refunded to the undersigned under the conditions of and in accordance with the terms of this Proposal which are as follows:

THAT: The undersigned has carefully examined the Plans and Specifications and all other Contract Documents and fully understands them.

THAT: The undersigned has carefully examined the site of the project and is familiar with the conditions under which the work, or any part thereof, is to be performed and the conditions which must be fulfilled in furnishing and/or installing, erecting or constructing any or all items of the Project.

\*Fill in appropriate Contract number(s):

THAT: The undersigned will provide all necessary tools, machinery, equipment, apparatus, and all other means necessary to do all the work and will furnish all labor, materials and all else required to complete such Contract as may be entered into, in the manner prescribed in and in accordance with the terms of the Specifications and the Contract and in accordance with the true

intent and meaning thereof, and in accordance with the Plans and/or Drawings and the requirements of the Consulting Engineers under them, in a first class manner.

THAT: The rights of the Owner and the recommendations of the Consulting Engineers are not to be questioned in the Award of Contracts.

THAT: It is the intention of the Owner to let Contracts on the basis of the Bids received in accordance with G.S. 143-129 and in such manner as they may deem to be for the best interests of the Owner.

THAT: The Owner reserves the right to reject any or all Proposals.

THAT: The work under each Section will be awarded under one Contract and that the Owner shall have the right to include such item or items as the Owner may deem to be in the best interests of the Owner.

THAT: On being awarded the Contract, the undersigned will execute a Performance Bond and a Payment Bond, on the forms included herein, each equal to one hundred percent (100%) of the Contract price, as security for the faithful performance of the Contract.

THAT: The undersigned shall submit, in the blank spaces provided, all data, guarantees and other information called for.

THAT: This Proposal shall be signed and submitted in the manner prescribed in the Instructions to Bidders.

THAT: Should this Proposal not be accepted by the Owner, the certified check, in the amount of: \_\_\_\_\_ Dollars (\$ \_\_\_\_\_) or the five percent (5%) Bid Bond, deposited herewith will be returned to the undersigned.

THAT: Should this Proposal be accepted by the Owner and the undersigned fail or neglect to execute the Contract and furnish the required Bonds within fifteen (15) days after receiving notifications of the acceptance of the Proposal and/or receipt of the formal Contract and Bond forms, the certified check, in the amount of: \_\_\_\_\_ Dollars (\$ \_\_\_\_\_) or the Bid Bond, deposited herewith shall be retained by the Owner as liquidated damages, it being understood that the Owner reserves the right to extend the time allowed for executing the Contract and/or furnishing the Bond.

THAT: The undersigned will complete such Contract as may be entered into within the number of consecutive calendar days specified in the Contract from the date of the Notice to Proceed.

**THAT:** The undersigned understands that E-Verify is the federal E-Verify program operated by the United States Department of Homeland Security and other federal agencies, or any successor or equivalent program used to verify the work authorization of newly hired employees pursuant to federal law in accordance with NCGS 64-25 et seq. The undersigned is aware of and in compliance with the requirements of E-Verify and Article 2 of Chapter 64 of the North Carolina General Statutes. To the best of the undersigned's knowledge, any subcontractors employed by the undersigned as part of this contract are in compliance with the requirements of E-Verify and Article 2 of Chapter 64 of the North Carolina General Statutes.

**THAT:** The undersigned proposes to enter into a Contract in accordance with this Proposal, the Plans and Specifications and the Contract Documents included herein, for the following price, or prices shown on the following pages.

**THAT:** It is the intent of these Contract Documents to obtain a Contract based on a Lump Sum Price except where Unit Prices are specifically requested. Where a discrepancy exists between words and numbers in the Bid amount, the written words shall govern.

PROPOSAL  
(BID FORM)  
SINGLE PRIME CONTRACT  
FOR  
MacDonald Downs Pump Station Relocation

The TOTAL SINGLE PRIME LUMP SUM BASE BID PRICE for completing all work included in all Contracts shall be as follows: (in words and numerals) \_\_\_\_\_

\_\_\_\_\_ Dollars and \_\_\_\_\_  
\_\_\_\_\_ Cents (\$ \_\_\_\_\_ ).

CONTRACTOR \_\_\_\_\_  
(Print)

Note: For a Single Prime Contract System all Bidders must identify on their Bid (below) the Contractor(s) they have selected for the subdivisions or branches of Work for:

General Construction: \_\_\_\_\_  
\_\_\_\_\_

The Bidder identified on Page 00300-1 shall be listed above as one of the subdivisions or branches.

NOTE: PROPOSAL SIGNATURE REQUIRED ON PAGE 00300-08. ALL PROPOSALS MUST BE PROPERLY EXECUTED TO BE CONSIDERED A VALID BID.



**CERTIFIED LIST OF EQUIPMENT/MATERIAL MANUFACTURERS**

The Bidder, \_\_\_\_\_, as part of the procedure for the submission of Bids on this project known as MacDonald Downs Pump Station Relocation \_\_\_\_\_, submits the following list of Equipment/Materials Manufacturers to be used in the performance of work to be done on said Project. The list of Manufacturers and all equipment/materials furnished shall be based on requirements of the Contract Documents. Changes to this list after the Bid opening shall only be as approved by the Owner upon request by the Contractor or as required by the Owner based upon review of Contractor's submittals:

EQUIPMENT/MATERIALS	MANUFACTURER
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

It is understood and agreed that, if awarded a Contract, the Contractor will not make any additions, deletions or substitutions to this Certified list without the consent of the Owner.

**CERTIFICATION AFFIDAVIT**

THE ABOVE INFORMATION IS TRUE AND COMPLETE TO THE BEST OF MY KNOWLEDGE AND BELIEF. I FURTHER UNDERSTAND AND AGREE THAT, IF AWARDED A CONTRACT, THIS CERTIFICATION SHALL BE ATTACHED THERETO AND BECOME A PART THEREOF.

NAME OF SIGNER: \_\_\_\_\_  
(Please Print or Type)

TITLE OF SIGNER:: \_\_\_\_\_  
(Please Print or Type)

SIGNATURE: \_\_\_\_\_

DATE: \_\_\_\_\_

**BID SECURITY:**

Accompanying this Proposal is a (a) \_\_\_\_\_ in the amount of  
(b) \_\_\_\_\_ Dollars (\$ \_\_\_\_\_).

NOTE: (a) Insert the words "bank draft," "certified check," "bid bond" as the case may be.

(b) Amount must be equal to at least five percent (5%) of the Total Base Bid.

**CONTRACTOR'S LICENSE:**

The undersigned certifies that (he/they) \_\_\_\_\_ (is/are) \_\_\_\_\_ licensed  
as a Contractor under the specific State law regulating \_\_\_\_\_ (his/their) particular  
trade and that the number of \_\_\_\_\_ (his/their) license, under which \_\_\_\_\_ (he/they)  
\_\_\_\_\_ (is/are) now operating is \_\_\_\_\_.

**LIQUIDATED DAMAGES:**

The undersigned agrees, further, that the Owner may retain those amounts indicated below from the amount of Compensation due the undersigned, under the terms of the Contract, for each and every day that the work remains incomplete beyond the completion date specified in the Notice to Proceed. This amount is agreed upon as the proper measure of liquidated damages the Owner will sustain, per day, by the failure of the undersigned to complete the work, within the stipulated time, and it is not to be construed, in any sense, as a penalty.

No Contractor shall have a claim against the Owner as a result of other construction Contractor's lack of progress or project completion.

**PROPOSAL SIGNATURE:** (Sign on Page 00300-08)

**CORPORATION:**

The Bidder is a corporation organized and existing under the laws of the State of \_\_\_\_\_, which operates under the legal name of \_\_\_\_\_ and the full names of its officers are as follows:

President \_\_\_\_\_

Secretary \_\_\_\_\_

Treasurer \_\_\_\_\_

Manager \_\_\_\_\_

and it does have a corporate seal. The President is authorized to sign construction proposals and Contracts for the company by action of its Board of Directors taken \_\_\_\_\_, a certified copy of which is hereto attached. (Strike out this last sentence if not applicable.)

**PARTNERSHIP:**

The business is a partnership consisting of individual partners whose full names are as follows:

_____	_____
_____	_____
_____	_____
_____	_____

The partnership does business under the legal name of

\_\_\_\_\_

**INDIVIDUAL:**

The Bidder is an individual whose full name is:

\_\_\_\_\_

and if operating under a trade name, said trade name is as follows:

---

---

(SIGN BELOW)

Dated \_\_\_\_\_, 20 \_\_\_\_

\_\_\_\_\_  
Legal Entity

(SIGN HERE) By: \_\_\_\_\_

SEAL-if corporation

\_\_\_\_\_  
Printed Name

Telephone No. ( ) \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_.

\_\_\_\_\_  
Notary Public

My Commission Expires:

\_\_\_\_\_

## BID BOND

This is a Bid Bond that is subject to the provisions of Article 3 of Chapter 44A of the North Carolina General statutes.

This Bond is executed on \_\_\_\_\_, 20 \_\_\_\_.

The name of the PRINCIPAL is \_\_\_\_\_ (1)

\_\_\_\_\_ (2)

The name of the SURETY is \_\_\_\_\_

\_\_\_\_\_

The City of Havelock is the OWNER

The amount of the Bond is \_\_\_\_\_

\_\_\_\_\_ (Dollars) (\$ \_\_\_\_\_)

KNOW BY ALL MEN BY THESE PRESENTS, the Principal and Surety above named are hereby held and firmly bound unto the above named OWNER hereinafter called the OWNER in the penal sum of the amount stated above in lawful money of the United States, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that whereas the Principal has submitted to the OWNER a certain Bid, attached hereto and hereby made a part hereof to enter into a Contract in writing, for the construction of:

MacDonald Downs Pump Station Relocation

NOW, THEREFORE

- (a) If said Bid shall be rejected, or in the alternate,
- (b) If said Bid shall be accepted and the Principal shall execute and deliver a Contract in the Form of Contract attached hereto (properly completed in accordance with said Bid) and shall furnish a bond for his faithful performance of said Contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said Bid, then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

\*Fill in Appropriate Contract No.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its Bond shall be in no way impaired or affected by any extension of the time within which the Owner may accept such Bid; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

ATTEST:

_____ (Principal Secretary) (SEAL)	_____ Principal
	BY: _____ (3)
	_____ (Address)
_____ Witness as to Principal	_____ Surety
_____ (Address)	_____ (Address)

ATTEST:

_____ N.C. Resident Agent (SEAL)
_____ Witness as to Surety
_____ (Address)

- (1) Correct name of Contractor
- (2) a Corporation, a Partnership or an Individual, as the case may be
- (3) If Contractor is a Partnership, all partners should execute Bond

**POWER OF ATTORNEY  
(Attach)**

**CONTRACTOR'S CERTIFICATES**  
**AFFIDAVIT OF ORGANIZATION AND AUTHORITY**  
**SWORN STATEMENT**

STATE OF \_\_\_\_\_ )

COUNTY OF \_\_\_\_\_ )

\_\_\_\_\_ being the first duly sworn on oath  
deposes and says that the Bidder on the attached Bid proposal is organized as indicated below  
and that all statements herein made are made on behalf of such Bidder and that this deponent is  
authorized to make them.

(Fill Out Applicable Paragraph)

**1. CORPORATION:**

The Bidder is a corporation organized and existing under the laws of the State of \_\_\_\_\_  
\_\_\_\_\_ and its President is \_\_\_\_\_; its  
Secretary is \_\_\_\_\_, and it does  
have a corporate seal. The \_\_\_\_\_ is authorized to  
sign construction Contracts and Bids for the company by action of its Board of Directors taken  
\_\_\_\_\_, a certified copy of which is hereto attached.  
(Strike out last sentence if not applicable.)

**2. PARTNERSHIP:**

The Bidder is a partnership consisting of \_\_\_\_\_ and \_\_\_\_\_  
\_\_\_\_\_, partners doing business under the name of \_\_\_\_\_.

**3. SOLE TRADER:**

The Bidder is an individual and if operating under a trade name, such trade name is as follows:  
\_\_\_\_\_.

**4. ADDRESS:**

The business address of the Bidder is as follows:

\_\_\_\_\_  
\_\_\_\_\_.

Its phone number is \_\_\_\_\_.

\_\_\_\_\_  
Bidder

By: \_\_\_\_\_



Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

\_\_\_\_\_  
Notary Public Co. \_\_\_\_\_

My Commission Expires:

\_\_\_\_\_

## **EQUAL EMPLOYMENT OPPORTUNITY**

During the performance of this Contract the Contractor agrees as follows:

- a. The Contractor will not discriminate against any employee or applicant because of race, color, religion, sex, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to race, color, religion, sex, or national origin. Such action shall include but not be limited to the following: employment, upgrading, demotion, or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of the nondiscrimination clause.
- b. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.
- c. The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other Contract understanding, a notice, to be provided, advising the labor union or worker's representative of the Contractor's commitments under the Equal Employment Opportunity Section of this Contract, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
- d. In the event of the Contractor's noncompliance with the nondiscrimination clauses of this Contract or with any of such rules, regulations, or orders, this Contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further OWNER Contracts.
- e. The Contractor will include the provisions of this section in every subcontract or purchase order unless exempted by rules, regulations, or orders of the OWNER so that such provisions will be binding upon each Subcontractor or vendor.

(Use the following form for signatures by a CORPORATION):

\_\_\_\_\_  
Corporate Name

ATTEST:

\_\_\_\_\_  
(Assistant) Secretary

\_\_\_\_\_  
(Vice) President

(CORPORATE SEAL)

(Use the following form for signatures by and INDIVIDUAL):

BY: \_\_\_\_\_ (Seal)

WITNESS:

\_\_\_\_\_

(ACKNOWLEDGEMENT OF THE ABOVE SIGNATURE MUST BE NOTARIZED USING FORM  
ON FOLLOWING PAGE)

## ACKNOWLEDGEMENT

(See the following form for acknowledgement signature by a Corporation):

NORTH CAROLINA

(Enter correct State and County if different than shown.)

\_\_\_\_\_ COUNTY

I, \_\_\_\_\_, a notary public in and for the aforesaid State and County, certify that \_\_\_\_\_ personally appeared before me this day and acknowledged that he is (Asst.) Secretary of \_\_\_\_\_, a corporation, and that by authority duly given and as the act of the corporation, the foregoing instrument was signed in its name by its (Vice) President, sealed with its corporate seal, and attested by himself as its (Asst.) Secretary.

WITNESS my hand and notarial seal this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

\_\_\_\_\_  
Notary Public

My commission expires \_\_\_\_\_  
(SEAL)

(Use the following form for acknowledgement signature by a partnership or an individual.)

NORTH CAROLINA

(Enter correct State and County if different than shown.)

\_\_\_\_\_ COUNTY

I, the undersigned Notary Public, do hereby certify that \_\_\_\_\_, personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

WITNESS my hand and notarial seal this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

\_\_\_\_\_  
Notary Public

My commission expires \_\_\_\_\_  
(SEAL)

**NONDISCRIMINATION CLAUSE**

It is specifically agreed as part of the consideration of the signing of this Contract that the parties hereto, their agents, officials, employees or servants will not discriminate in any manner on the basis of age, handicap, race, color, creed, sexual orientation or national origin with reference to the subject matter of this Contract, no matter how remote.

This provision being incorporated for the benefit of the City of Havelock and its residents may be enforced as set out in said ordinances, enforcement of this provision shall be by action for specific performance, injunctive relief, or other remedy as by law provided.

This provision shall be binding on the successors and assigns of the parties hereto with reference to the subject matter of this Contract.

(Use the following form for signatures by a CORPORATION):

\_\_\_\_\_  
Corporate Name

ATTEST:

\_\_\_\_\_  
(Assistant) Secretary

BY:

\_\_\_\_\_  
Vice President

\_\_\_\_\_  
(Printed Name)

BY:

\_\_\_\_\_  
(Printed Name)

(Corporate Seal)

(Use the following form for signatures by an INDIVIDUAL):

BY: \_\_\_\_\_(SEAL)

\_\_\_\_\_  
(Printed Name)

WITNESS:

\_\_\_\_\_  
\_\_\_\_\_  
(Printed Name)

## QUALIFICATIONS OF BIDDERS

In order to assist the Owner in determining whether the Bidder is qualified to perform the Work, as set forth in the Contract Documents, the Bidder shall furnish the following information.

1. List of references who are qualified to judge as to his financial responsibility and his experience in work of similar nature to that bid upon:
2. List of previous contracting experience, including dollar values of contracts:
3. List of facilities or equipment that is available for use:
4. Name, residence, and title of the individual who will give personal attention to the work:
5. Financial Statement:

### ASSETS

#### CURRENT ASSETS:

Cash	\$ _____
Notes and Accounts Receivable	_____
Inventories	_____

#### PLANT ASSETS:

Real Estate	\$ _____
Machinery	_____
Good Will, Patents, etc.	_____ \$ _____

LIABILITIES:

Notes Payable	\$ _____	
Accounts Payable	\$ _____	
Accrued Wages	_____	
Other Liabilities	_____	\$ _____
	EXCESS OF ASSETS OR NET WORTH	\$ _____

Notes:

- A. The above is a suggested form for the Financial Statement, and the Bidder is not required to follow the form explicitly. The Financial Statement submitted must clearly show to the satisfaction of the Owner the Bidders current financial condition. The Owner reserves the privilege of requiring additional information as to financial responsibility of the Bidder prior to awarding Contract.
- B. Bidder shall attach additional pages, if necessary, in order to complete the required information.
- C. The Bidder shall submit detailed information required for above items 1 through 4 with his Bid package and at the discretion of the Bidder the information required under Item 5 can be furnished after Bids are received if required by the Owner and Engineer to evaluate the financial qualifications of a prospective Bidder.

**NON-COLLUSIVE AFFIDAVIT**

State of \_\_\_\_\_

County of \_\_\_\_\_

\_\_\_\_\_ being first duly sworn,  
deposes and says that:

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

BY \_\_\_\_\_

ITS \_\_\_\_\_  
(Title)

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_ .

\_\_\_\_\_  
Notary Public

My Commission Expires:  
\_\_\_\_\_

END OF AFFIDAVIT



## NOTICE OF AWARD

TO: CONTRACTOR: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

FROM: Hazen and Sawyer  
Raleigh, North Carolina

OWNER: \_\_\_\_\_

PROJECT: \_\_\_\_\_

You are hereby notified that the Owner has considered the Proposal submitted by you for the above-described project in response to its Notice to Bidders dated \_\_\_\_\_ , 20 \_\_\_\_ .

It appears that it is to the best interest of said Owner to accept your Proposal in the amount of: \_\_\_\_\_ Dollars (\$ \_\_\_\_\_ ), and you are hereby  
Notified that your Proposal has been accepted for \_\_\_\_\_

The Contractor is required by these Contract Documents to execute and deliver the formal Contract with the undersigned Owner and to furnish the required Contractor's Performance and Payment Bonds within fifteen (15) days from the date of the delivery of this Notice to you.

If you fail to execute said Contract and to furnish said Bond within fifteen (15) days from the date of delivery of this Notice, said Owner will be entitled to consider all your rights arising out of the Owner's acceptance of your Proposal as abandoned and to award the work covered by your Proposal to another, or to readvertise the work or otherwise dispose thereof as the Owner may see fit.

Dated this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_.

Hazen and Sawyer

By: \_\_\_\_\_

Title: \_\_\_\_\_

#### **ACCEPTANCE OF NOTICE**

Receipt of the above Notice of Award is hereby acknowledged this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_.

By: \_\_\_\_\_

Title: \_\_\_\_\_

- END OF SECTION -

SECTION 00500

**INSTRUCTIONS TO CONTRACTORS AND  
REQUIREMENTS AS TO FORM FOR HAVELOCK, NC CONTRACTS  
DO NOT REMOVE FROM CONTRACT**

Please observe the following in executing the attached Contract:

1. The Owner may Contract with three types of legal entities.
  - (a) If the Contract is with an individual, that individual should sign the Contract exactly as his name is set out. If the Contract is with an individually-owned business, the Contract should be with the individual owner, and not the named business.
  - (b) Execution on behalf of a corporation should be by the president or a vice president, attested by the corporate secretary, with the corporate seal affixed. An official other than president or vice president should attach documentation of his authority to execute and bind the company.
  - (c) If the Contract is with a partnership, all members of the partnership should execute unless an authorized partner is designated to execute. Documentation of such authorization should be attached.
2. After signing the Contract, the appropriate notary's acknowledgement, either in the corporate form or individual/partnership form should be completed.
3. The Performance and Payment Bonds should be attached to the Contract package. They should be signed by the Contractor, and his signature should be acknowledged with the appropriate acknowledge form. Next, the Bonds, in approved form, must be signed by the authorized agent of the Surety Company issuing the Bonds, and an executed Power of Attorney document authorizing the agent to sign must accompany the Bond Documents.
4. The Contract should not be dated, except by the last person executing the Contract.
5. The Bid Form and all other documents submitted with the Bid shall be included with the Contract.
6. Submit the Acceptance of Notice.
7. Page 00500-3: Complete in its entirety.
8. Page 00500-5: Complete in its entirety.
9. Pages 00500-7 through 00500-14: Complete in entirety.
10. Page 00500-14: Certificate of Insurance, Article 5 of the General and Supplementary Conditions requires the Certificate of Insurance to have the Indemnification Agreement copied on the reverse side of the Certificate. Article 5 also requires, under Subsection 5.02, first Paragraph, those to be named as Insured in each policy issued.
11. Most Certificates of Insurance state under the cancellation clause that "the issuing company will endeavor to mail 30 days written notice to the ..." and "but failure to mail such notice shall

impose no obligation or liability of any kind upon the Company, its agents or representatives".  
If your certificate states this, the words "endeavor to" and "but failure to mail such notice shall impose no obligation or liability of any kind upon the Company, its agents or representatives" must be stricken in order to comply with the Contract Documents.

12. Four copies of the Contract are sent to the Contractor. The original and duplicates should be signed and returned to the Engineer for signature by the Owner, after which one duplicate will be returned to the Contractor.
13. Failure to fully complete all four sets of the Contract Documents will cause delays in the approval by the Owner and therefore delay the issuance of the Notice to Proceed.

## CONTRACT

This Contract made this \_\_\_\_\_ day of \_\_\_\_\_, in the year 20\_\_\_\_, by and between the  
City of Havelock, North Carolina, party of the first part, hereinafter called the Owner, and

\_\_\_\_\_ of \_\_\_\_\_, party  
of the second part, hereinafter called the Contractor.

## WITNESSETH

THAT, WHEREAS, a Contract for:

### MACDONALD DOWNS PUMP STATION RELOCATION

as prepared by Hazen and Sawyer, P.C. Environmental Engineers and Scientists, hereinafter called Engineers, has recently been awarded to the Contractor by the Owner at and for a sum equal to the aggregate cost of the work to be done and labor, materials, equipment, apparatus and supplies furnished at the prices and rates respectively named therefor, in the Proposal attached hereto:

AND WHEREAS, it was one of the conditions of said Award that a formal Contract should be executed by and between the Owner and the Contractor, evidencing the terms of said Award, and that the Contractor shall commence the work to be performed under this Agreement on a date to be specified in a written order of the Owner, and shall fully complete all work hereunder within  
185 CONSECUTIVE CALENDAR DAYS, of the date specified in the Notice to Proceed.

NOW THEREFORE, THIS CONTRACT FURTHER WITNESSETH THAT, the Contractor doth hereby covenant and agree with the Owner that they will well and faithfully perform and execute such work and furnish such labor, materials, equipment, apparatus and supplies, in accordance with each and every one of the conditions, covenants, stipulations, terms and provisions contained in the Specifications and in accordance with the Plans, at and for a sum equal to the aggregate cost of the work done and labor, materials, equipment, apparatus and supplies furnished at the prices and rates respectively named therefore in the Proposal attached hereto, and will well and faithfully comply with and perform each and every obligation imposed upon them by said Plans and Specifications and the terms of said Award.

The Contractor shall promptly make payments to all persons supplying materials in the prosecution of the work, and to all laborers and others employed thereon.

The Contractor shall be responsible for all damages to the property of the Owner that may be consequent upon the normal procedure of their work or that may be caused by or result from the negligence of the Contractor, his, its or their employees or agents, during the progress of, or connected with the prosecution of the work, whether within the limits of the work or elsewhere. The Contractor must restore all property so injured to a condition as good as it was when the Contractor entered upon the work.

The Contractor shall furthermore be responsible for, and be required to make good at his, its or their expense, any and all damages of whatever nature, to persons or property, arising during the period of this Contract, caused by carelessness, neglect, or want of due precaution on the part of the Contractor, shall also indemnify and save harmless the Owner, and the officers and agents thereof, from all claims, suits, and proceedings of every name and description which may be brought against

the Owner, or the officers and agents thereof, for or on account of any injuries or damages to persons or property received or sustained by any person or persons, firm or corporation, or by or in consequence of any materials or workmanship in its construction, or by or on account of any accident, or of any other act or omission of the said Contractor, his, its, or their agents, employees, servants or workmen.

It is agreed and understood that the Notice to Bidders, Instructions to Bidders, General Conditions, Supplementary Conditions, Technical Specifications, together with the enumerated Addenda, if any, the Proposal, and the Plans and/or Drawings are a part and parcel to this Contract to the same extent as if incorporated herein in full.

It is further mutually agreed between the parties hereto that if, at any time after the execution of this Agreement and the performance and payment Bonds hereto attached for its faithful performance and payment, the Owner shall deem the surety or sureties upon such Bonds to be unsatisfactory, or if, for any reason, such Bonds cease to be adequate to cover the performance or payment of the work, the Contractor shall, at his, its or their expense, within five (5) days after the receipt of notice from the Owner so to do, furnish an additional Bond or Bonds in such form and amount and with such surety or sureties as shall be satisfactory to the Owner. In such event no further payment to the Contractor shall be deemed to be due under this agreement until such new or additional security for the faithful performance and payment of the work shall be furnished in a manner and form satisfactory to the Owner.

And the Owner does hereby covenant and agree with the Contractor that it will pay to the Contractor, when due and payable under the terms of the Contract Documents and the Award, the sum mentioned above, and that it will well and faithfully comply with and perform each and every obligation imposed upon it by said Contract Documents and the terms of said Award.

#### LIQUIDATED DAMAGES

The parties recognize that Owner will suffer financial loss if the Work is not substantially completed within the Contract Time. They also recognize the delays, expense, and difficulty to both parties involved in proving or contesting the amounts of those losses. Instead of requiring proof of those amounts, it is agreed that Contractor shall be liable for and shall pay Owner the following amounts under Owner's Damages, and Engineer's Charges, all as liquidated damages, and not as a penalty.

	<u>Owner's Damages</u>	<u>Engineering Charges</u>	<u>Total Liquidated Damages</u>
MacDonald Downs Pump Station Relocation	\$1,000/day	\$400/day	\$1,400/day

Liquidated damages will be assessed for the above listed amount(s) for each and every day the work remains incomplete after the completion date(s) listed above. Liquidated damages for late completion of the above listed facilities and overall project shall be additive.

Completion for above listed item(s) shall be defined as completely installed including all associated appurtenances, tested and ready for the intended service.

The parties recognize that Owner will suffer financial loss if the Work is not substantially completed within the Contract Time. They also recognize the delays, expense, and difficulty to both parties involved in proving or contesting the amounts of those losses. Instead of requiring proof of those amounts, it is agreed that Contractor shall be liable for and shall pay Owner the following amounts under General Damages, and Engineer's Charges, all as liquidated damages, and not as a penalty.

FURTHER AGREEMENTS

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IN WITNESS WHEREOF, said \_\_\_\_\_ has caused these presents to be signed in its corporate name by its \_\_\_\_\_ its corporate seal to be hereto affixed and attested by its secretary, and the Owner has caused these presents to be executed in its name by the City Manager, attested by its City Clerk and its Official Corporate Seal to be affixed all by order of its City Council as of the day and year first above written.

\_\_\_\_\_  
(SEAL)

\_\_\_\_\_  
(SEAL)

ATTEST

\_\_\_\_\_  
(SEAL)

\_\_\_\_\_  
Secretary  
(SEAL)

By: \_\_\_\_\_

Title: \_\_\_\_\_

ATTEST: CITY OF HAVELOCK , NORTH CAROLINA

\_\_\_\_\_  
(TITLE)  
(SEAL) BY: \_\_\_\_\_ , City Manager

IMPORTANT

NOTE: If the Contractor is a Corporation, the legal name of the Corporation shall be set forth above, together with the signature of the officer or officers authorized to sign Contracts on behalf of the Corporation; if Contractor is a partnership, the true name of the firm shall be set forth above, together with the signatures of all the partners; and if Contractor is an individual, his signature shall be placed above. If signature is by an agent other than an officer of a Corporation or a member of a partnership, a Power of Attorney must be attached hereto. Signature of Contractor shall also be acknowledged before a Notary Public or other person authorized by law to execute such acknowledgment.

OWNER'S AFFIDAVIT

STATE OF \_\_\_\_\_

COUNTY OF \_\_\_\_\_

THIS IS TO CERTIFY that on this day personally appeared before me \_\_\_\_\_, with whom I am personally acquainted, who, being by me duly sworn, says that \_\_\_\_\_ is the City Manager and that \_\_\_\_\_ he, the said \_\_\_\_\_, is the City Clerk of the City of Havelock \_\_\_\_\_, the Municipal Corporation described in and which executed the foregoing Contract; that \_\_\_\_\_ he knows the common seal of said corporation; that the seal affixed to the said instrument is said common seal; that the name of the Corporation was subscribed thereto by the said City Manager and that the said City Manager and said City Clerk subscribed their names thereto and said common seal was affixed, all by order of the City Council of the City of Havelock \_\_\_\_\_, and that said instrument is the act and deed of said Corporation.

Witness my hand and notarial seal, this the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

\_\_\_\_\_  
Notary Public

My commission expires: \_\_\_\_\_



CONTRACTOR'S AFFIDAVIT

STATE OF \_\_\_\_\_

COUNTY OF \_\_\_\_\_

THIS IS TO CERTIFY that on this day personally appeared before me \_\_\_\_\_ with whom I am personally acquainted, who, being duly sworn, says that \_\_\_\_\_ is the \_\_\_\_\_ President and that the said \_\_\_\_\_ is the \_\_\_\_\_ Secretary of \_\_\_\_\_ the Corporation described in and which executed the foregoing Contract; that he knows the common seal of said corporation; that the seal affixed to the said instrument is said common seal; that the name of the corporation was subscribed thereto by the said \_\_\_\_\_ President and that the said \_\_\_\_\_ President and \_\_\_\_\_ Secretary subscribed their names thereto and said common seal was affixed, all by order of the Board of Directors of said Corporation, and said instrument is the act and Deed of said Corporation.

Witness my hand and notarial seal, this the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

\_\_\_\_\_  
Notary Public

My commission expires: \_\_\_\_\_

## PERFORMANCE BOND

This Bond is executed on \_\_\_\_\_, 20 \_\_\_\_.

The name of the PRINCIPAL is \_\_\_\_\_ (1)

a \_\_\_\_\_ (2)

The name of the SURETY is \_\_\_\_\_  
\_\_\_\_\_

The **CITY OF HAVELOCK**, NORTH CAROLINA is the CONTRACTING BODY.

The amount of the Bond is \_\_\_\_\_  
\_\_\_\_\_ Dollars (\$) \_\_\_\_\_ )

KNOW ALL MEN BY THESE PRESENTS, that we, the PRINCIPAL and SURETY above named, are held and firmly bound unto the above named CONTRACTING BODY, hereinafter called the Contracting Body, in the penal sum of the amount stated above in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas, the Principal entered into a certain Contract with the Contracting Body, dated the \_\_\_ day of \_\_\_\_\_, 20\_\_\_\_ for work described by Plans and Specifications prepared by Hazen and Sawyer of Raleigh, North Carolina, herein called and referred to as the Engineers, a copy of said Contract is hereto attached and made a part hereof for the construction of:

### MACDONALD DOWNS PUMP STATION RELOCATION

NOW THEREFORE, if the Principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of said Contract during the original term of said Contract and any extensions thereof that may be granted by the Contracting Body, with or without notice to the Surety, and during the life of any guaranty required under the Contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of any and all duly authorized modifications of said Contract that may hereafter be made, notice of which modifications to the SURETY being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

ATTEST:

\_\_\_\_\_  
(Principal) Secretary  
(SEAL)

\_\_\_\_\_  
Principal

By: \_\_\_\_\_ (3)

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
Witness as to Principal

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(Surety)

ATTEST:

\_\_\_\_\_  
N.C. Resident Agent  
(SEAL)

By: \_\_\_\_\_  
Attorney-in-Fact

\_\_\_\_\_  
Witness as to Surety

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(Address)

NOTE: Date of Bond must not be prior to date of Contract

- (1) Correct name of Contractor
- (2) a Corporation, a Partnership or an Individual, as the case may be
- (3) If Contractor is a Partnership, all partners should execute Bond

PAYMENT BOND

This Bond is executed on \_\_\_\_\_, 20 \_\_\_\_ .

The name of the PRINCIPAL is \_\_\_\_\_ (1)

a \_\_\_\_\_ (2)

The name of the SURETY is \_\_\_\_\_  
\_\_\_\_\_

The **CITY OF HAVELOCK** , NORTH CAROLINA is the CONTRACTING BODY.

The amount of the Bond is \_\_\_\_\_  
\_\_\_\_\_ Dollars (\$) \_\_\_\_\_ )

KNOW ALL MEN BY THESE PRESENTS, that we, the PRINCIPAL and SURETY above named, are held and firmly bound unto the above named CONTRACTING BODY, hereinafter called the Contracting Body, in the penal sum of the amount stated above in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas, the Principal entered into a certain Contract with the Contracting Body, dated the \_\_ day of \_\_\_\_\_, 20\_\_\_\_.  
for work described by Plans and Specifications prepared by Hazen and Sawyer, Environmental Engineers and Scientists of Raleigh, North Carolina, herein called and referred to as the Engineers, a copy of said Contract is hereto attached and made a part hereof for the construction of:

**MACDONALD DOWNS PUMP STATION RELOCATION**

NOW THEREFORE, if the Principal shall promptly make payment to all persons supplying labor and material in the prosecution of the work provided for in said Contract, and any and all duly authorized modifications of said Contract that may hereafter be made, notice of which modifications to the SURETY being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

ATTEST:

\_\_\_\_\_  
(Principal) Secretary  
(SEAL)

\_\_\_\_\_  
Principal

By: \_\_\_\_\_ (3)

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
Witness as to Principal

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(Surety)

ATTEST:

\_\_\_\_\_  
N.C. Resident Agent  
(SEAL)

By: \_\_\_\_\_  
Attorney-in-Fact

\_\_\_\_\_  
Witness as to Surety

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(Address)

NOTE: Date of Bond must not be prior to date of Contract

- (1) Correct name of Contractor
- (2) a Corporation, a Partnership or an Individual, as the case may be
- (3) If Contractor is a Partnership, all partners should execute Bond

AFFIDAVIT

(To be attached to all Contracts)

STATE OF \_\_\_\_\_ )  
COUNTY OF \_\_\_\_\_ ) SS

\_\_\_\_\_ being first duly sworn on oath deposes and says  
that he is \_\_\_\_\_ (attorney-in-fact or agent) of  
\_\_\_\_\_ (bonding company) surety on the attached Contract on  
\_\_\_\_\_ executed by  
\_\_\_\_\_ (Contractor).

Affiant further deposes and says that no officer, official or employee of the Owner has any interest directly or indirectly, or is receiving any premium, commission fee or other thing of value on account of the same or furnishing of the Bond, undertaking or Contract of Indemnity, Guaranty, Suretyship in connection with the above mentioned Contract.

Signed \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, A.D., 20 \_\_\_\_\_.

\_\_\_\_\_  
(Notary Public, \_\_\_\_\_ County, \_\_\_\_\_ )

My Commission Expires \_\_\_\_\_

POWER OF ATTORNEY

(Attach)

CERTIFICATE OF INSURANCE

(Attach)

See Supplementary Conditions Article 5 for specific requirements.



CERTIFICATE OF ATTORNEY

I hereby certify that I am the duly appointed attorney for the Owner of the Project and that I have examined the foregoing instrument and Bond, and insurance documents and I have approved the same as being legal and in proper form.

This \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_.

\_\_\_\_\_  
Attorney-at-Law

CERTIFICATE OF PAYMENTS

I hereby certify that I am the legal and duly appointed Financial Officer for the Owner of this project and that provision for the payment of the moneys to fall due under this agreement has been made by appropriation duly made or by Bonds or notes duly authorized, as required by the Local Government and Fiscal Control Act.

BY: \_\_\_\_\_

TITLE: \_\_\_\_\_

DATE: \_\_\_\_\_

NOTICE TO PROCEED

TO: CONTRACTOR: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

\_\_\_\_\_

FROM: Hazen and Sawyer  
Raleigh, North Carolina

OWNER: CITY OF HAVELOCK

\_\_\_\_\_

PROJECT: MACDONALD DOWNS PUMP STATION RELOCATION

\_\_\_\_\_

Contract No. 1 Contract Amount \$ \_\_\_\_\_

You are hereby notified to commence work on the referenced project on or before  
\_\_\_\_\_ and are to fully complete the work within \_\_\_\_\_ CONSECUTIVE  
CALENDAR DAYS thereafter. Your Contract completion date is therefore  
\_\_\_\_\_ .

The Contract provides for assessment of liquidated damages for each consecutive calendar day  
after the above established Contract completion date that the work remains incomplete.

Hazen & Sawyer

By: \_\_\_\_\_

TITLE: \_\_\_\_\_

DATE: \_\_\_\_\_



## SECTION 00700

### STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT



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

# STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

**ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE**

and

Issued and Published Jointly by



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Endorsed by



CONSTRUCTION SPECIFICATIONS INSTITUTE

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

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# STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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## ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

### 1.01 *Defined Terms*

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

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

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

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



51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

## 1.02 *Terminology*

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

B. *Intent of Certain Terms or Adjectives:*

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

C. *Day:*

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

D. *Defective:*

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
  - a. does not conform to the Contract Documents; or
  - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

- c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

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

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

## **ARTICLE 2 – PRELIMINARY MATTERS**

### **2.01 *Delivery of Bonds and Evidence of Insurance***

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

### **2.02 *Copies of Documents***

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

### **2.03 *Commencement of Contract Times; Notice to Proceed***

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

Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

#### 2.04 *Starting the Work*

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

#### 2.05 *Before Starting Construction*

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

#### 2.06 *Preconstruction Conference; Designation of Authorized Representatives*

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

#### 2.07 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete

and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

### **ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE**

#### **3.01 *Intent***

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

#### **3.02 *Reference Standards***

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

the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

### 3.03 *Reporting and Resolving Discrepancies*

#### A. *Reporting Discrepancies:*

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

#### B. *Resolving Discrepancies:*

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

### 3.04 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.

- B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:
1. A Field Order;
  2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or
  3. Engineer's written interpretation or clarification.

### 3.05 *Reuse of Documents*

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

### 3.06 *Electronic Data*

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

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

### **4.01   *Availability of Lands***

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

### **4.02   *Subsurface and Physical Conditions***

- A. *Reports and Drawings:* The Supplementary Conditions identify:
  - 1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and
  - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
  - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
  - 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
  - 3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

#### 4.03 *Differing Subsurface or Physical Conditions*

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

1. is of such a nature as to establish that any “technical data” on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or
2. is of such a nature as to require a change in the Contract Documents; or
3. differs materially from that shown or indicated in the Contract Documents; or
4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

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

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

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor’s cost of, or time required for, performance of the Work; subject, however, to the following:
  - a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and
  - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:
  - a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or
  - b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and



contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

- c. Contractor failed to give the written notice as required by Paragraph 4.03.A.
- 3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

#### 4.04 *Underground Facilities*

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

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

B. *Not Shown or Indicated:*

- 1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the

consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

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

#### 4.05 *Reference Points*

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

#### 4.06 *Hazardous Environmental Condition at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
  1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
  2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
  3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

- C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.
- D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.
- E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.
- F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.
- G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

- H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

## **ARTICLE 5 – BONDS AND INSURANCE**

### **5.01   *Performance, Payment, and Other Bonds***

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

### **5.02   *Licensed Sureties and Insurers***

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

meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

#### 5.03 *Certificates of Insurance*

- A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.
- B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.
- C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.
- D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.
- E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

#### 5.04 *Contractor's Insurance*

- A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:
  - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
  - 2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
  - 3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;
  - 4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

- a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or
    - b. by any other person for any other reason;
  5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
  6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.
- B. The policies of insurance required by this Paragraph 5.04 shall:
1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;
  2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;
  3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;
  4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);
  5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and
  6. include completed operations coverage:
    - a. Such insurance shall remain in effect for two years after final payment.
    - b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

## 5.05 *Owner's Liability Insurance*

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

## 5.06 *Property Insurance*

- A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
  - 1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;
  - 2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.
  - 3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
  - 4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;
  - 5. allow for partial utilization of the Work by Owner;
  - 6. include testing and startup; and
  - 7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued.
- B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors,

members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.

- C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.
- D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.
- E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

#### 5.07 *Waiver of Rights*

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



1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
  2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

#### 5.08 *Receipt and Application of Insurance Proceeds*

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

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

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

interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

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

**ARTICLE 6 – CONTRACTOR’S RESPONSIBILITIES**

6.01 *Supervision and Superintendence*

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

6.02 *Labor; Working Hours*

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

6.03 *Services, Materials, and Equipment*

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

- B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

#### 6.04 *Progress Schedule*

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

#### 6.05 *Substitutes and "Or-Equals"*

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.
  - 1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:
    - a. in the exercise of reasonable judgment Engineer determines that:
      - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

- 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and
  - 3) it has a proven record of performance and availability of responsive service.
- b. Contractor certifies that, if approved and incorporated into the Work:
- 1) there will be no increase in cost to the Owner or increase in Contract Times; and
  - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. *Substitute Items:*

- a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.
- b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.
- c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.
- d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
  - 1) shall certify that the proposed substitute item will:
    - a) perform adequately the functions and achieve the results called for by the general design,
    - b) be similar in substance to that specified, and
    - c) be suited to the same use as that specified;
  - 2) will state:
    - a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,
    - b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

- c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;
  - 3) will identify:
    - a) all variations of the proposed substitute item from that specified, and
    - b) available engineering, sales, maintenance, repair, and replacement services; and
  - 4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.
- B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.
- C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.
- D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- E. *Engineer's Cost Reimbursement:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- F. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

#### 6.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be

required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

- B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.
- C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:
  - 1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor
  - 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.
- D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.
- E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.
- F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner,

Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

#### 6.07 *Patent Fees and Royalties*

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

#### 6.08 *Permits*

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

## 6.09 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

## 6.10 *Taxes*

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

## 6.11 *Use of Site and Other Areas*

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

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



by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

#### 6.12 *Record Documents*

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

#### 6.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:
  - 1. all persons on the Site or who may be affected by the Work;
  - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
  - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.
- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

#### 6.14 *Safety Representative*

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

#### 6.15 *Hazard Communication Programs*

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

#### 6.16 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are

required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

#### 6.17 *Shop Drawings and Samples*

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

1. *Shop Drawings:*

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

2. *Samples:*

- a. Submit number of Samples specified in the Specifications.
- b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Submittal Procedures:*

1. Before submitting each Shop Drawing or Sample, Contractor shall have:

- a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
- b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
- c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

- d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.
3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

*D. Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

*E. Resubmittal Procedures:*

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

**6.18** *Continuing the Work*

- A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any

disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

#### 6.19 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
  - 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
  - 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
  - 1. observations by Engineer;
  - 2. recommendation by Engineer or payment by Owner of any progress or final payment;
  - 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
  - 4. use or occupancy of the Work or any part thereof by Owner;
  - 5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;
  - 6. any inspection, test, or approval by others; or
  - 7. any correction of defective Work by Owner.

#### 6.20 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the

extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
  - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
  - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

#### 6.21 *Delegation of Professional Design Services*

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

- D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

## **ARTICLE 7 – OTHER WORK AT THE SITE**

### **7.01    *Related Work at Site***

- A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:
  - 1. written notice thereof will be given to Contractor prior to starting any such other work; and
  - 2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.
- B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.
- C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

### **7.02    *Coordination***

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

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
  2. the specific matters to be covered by such authority and responsibility will be itemized; and
  3. the extent of such authority and responsibilities will be provided.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

#### 7.03 *Legal Relationships*

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

### **ARTICLE 8 – OWNER'S RESPONSIBILITIES**

#### 8.01 *Communications to Contractor*

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

#### 8.02 *Replacement of Engineer*

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

#### 8.03 *Furnish Data*

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

#### 8.04 *Pay When Due*

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

#### 8.05 *Lands and Easements; Reports and Tests*

- A. Owner's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and



tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.06 *Insurance*

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

8.07 *Change Orders*

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

8.08 *Inspections, Tests, and Approvals*

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

8.09 *Limitations on Owner's Responsibilities*

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

8.10 *Undisclosed Hazardous Environmental Condition*

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

8.11 *Evidence of Financial Arrangements*

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

8.12 *Compliance with Safety Program*

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

## **ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION**

9.01 *Owner's Representative*

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

## 9.02 *Visits to Site*

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

## 9.03 *Project Representative*

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

## 9.04 *Authorized Variations in Work*

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

9.05 *Rejecting Defective Work*

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

9.06 *Shop Drawings, Change Orders and Payments*

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

9.07 *Determinations for Unit Price Work*

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

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

- A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.
- B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.
- C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

- D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

#### 9.09 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

#### 9.10 *Compliance with Safety Program*

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

### **ARTICLE 10 – CHANGES IN THE WORK; CLAIMS**

#### 10.01 *Authorized Changes in the Work*

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

- B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

#### 10.02 *Unauthorized Changes in the Work*

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

#### 10.03 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:
1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;
  2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
  3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

#### 10.04 *Notification to Surety*

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

#### 10.05 *Claims*

- A. *Engineer's Decision Required:* All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

- B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).
- C. *Engineer's Action:* Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:
1. deny the Claim in whole or in part;
  2. approve the Claim; or
  3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.
- D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.
- E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.
- F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

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

### **11.01 *Cost of the Work***

- A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing

in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
  - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
  - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

- c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
- d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
- e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
- f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.
- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

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

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



3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
  4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
  5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.
- C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.
- D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

## 11.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances:*
1. Contractor agrees that:
    - a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
    - b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance:*
1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

### 11.03 *Unit Price Work*

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

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

### 12.01 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:
  - 1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or
  - 2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

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

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

1. a mutually acceptable fixed fee; or
2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
  - a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;
  - b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;
  - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;
  - d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;
  - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
  - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

## 12.02 *Change of Contract Times*

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

### 12.03 *Delays*

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

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

### 13.01 *Notice of Defects*

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

### 13.02 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and

testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

### 13.03 *Tests and Inspections*

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:
  - 1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;
  - 2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and
  - 3. as otherwise specifically provided in the Contract Documents.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.
- E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.
- F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

### 13.04 *Uncovering Work*

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

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

#### 13.05 *Owner May Stop the Work*

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

#### 13.06 *Correction or Removal of Defective Work*

- A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).
- B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

#### 13.07 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract

Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or
  2. correct such defective Work; or
  3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
  4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

#### 13.08 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's

recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

#### **13.09 *Owner May Correct Defective Work***

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

### **ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION**

#### **14.01 *Schedule of Values***

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



## 14.02 *Progress Payments*

### *A. Applications for Payments:*

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

### *B. Review of Applications:*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
  - a. the Work has progressed to the point indicated;
  - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and
  - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
  - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or
  - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
  - a. to supervise, direct, or control the Work, or
  - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
  - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
  - d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or
  - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:
  - a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
  - b. the Contract Price has been reduced by Change Orders;
  - c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
  - d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

*C. Payment Becomes Due:*

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

*D. Reduction in Payment:*

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

*14.03 Contractor's Warranty of Title*

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

*14.04 Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.

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

#### 14.05 *Partial Utilization*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
  - 1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.
  - 2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

#### 14.06 *Final Inspection*

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

#### 14.07 *Final Payment*

##### *A. Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
  - a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;
  - b. consent of the surety, if any, to final payment;
  - c. a list of all Claims against Owner that Contractor believes are unsettled; and
  - d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid

or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

*B. Engineer's Review of Application and Acceptance:*

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

*C. Payment Becomes Due:*

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

**14.08** *Final Completion Delayed*

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

**14.09** *Waiver of Claims*

- A. The making and acceptance of final payment will constitute:
  1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees

specified therein, or from Contractor's continuing obligations under the Contract Documents;  
and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

## **ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION**

### **15.01 *Owner May Suspend Work***

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

### **15.02 *Owner May Terminate for Cause***

- A. The occurrence of any one or more of the following events will justify termination for cause:
  1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);
  2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
  3. Contractor's repeated disregard of the authority of Engineer; or
  4. Contractor's violation in any substantial way of any provisions of the Contract Documents.
- B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:
  1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);
  2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and
  3. complete the Work as Owner may deem expedient.

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

#### 15.03 *Owner May Terminate For Convenience*

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



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

#### 15.04 *Contractor May Stop Work or Terminate*

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

### **ARTICLE 16 – DISPUTE RESOLUTION**

#### 16.01 *Methods and Procedures*

- A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.
- B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.
- C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:
  - 1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or
  - 2. agrees with the other party to submit the Claim to another dispute resolution process; or
  - 3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

## ARTICLE 17 – MISCELLANEOUS

### 17.01 *Giving Notice*

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

### 17.02 *Computation of Times*

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

### 17.03 *Cumulative Remedies*

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

### 17.04 *Survival of Obligations*

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

### 17.05 *Controlling Law*

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

### 17.06 *Headings*

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

## SECTION 00800

### SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (EJCDC C-700) (2007 Edition) 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.

#### ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

##### 1.01 Defined Terms

##### 1.01.A.12 Replace in its entirety with the following:

“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, 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 Hardcopies of the items listed in this paragraph are Contract Documents. Files in electronic format of text, data, graphics, and the like that may be furnished by Owner to Contractor are not Contract Documents.”

##### 1.01.A.44 First sentence, change: "in the opinion of the Engineer", to "in the opinion of Engineer and Owner".

##### 1.02 Terminology

Delete 1.02.E and replace with the following:

##### 1.02.E The words "furnish", "furnish and install", "install", and "provide" or words with similar meaning shall be interpreted, unless otherwise specifically stated, to mean "furnish and install complete in place and ready for service".

Add the following:

- 1.02.G            The terms used in these Supplementary Conditions which are defined in the Standard General Conditions of the Construction Contract (EJCDC C-700, 2002 Edition) have the meanings assigned to them in the General Conditions.

## ARTICLE 2 - PRELIMINARY MATTERS

Add the following:

- 2.00            Execution of Agreement:
- 2.00.A            At least four counterparts of the Agreement will be executed and delivered by the Contractor to the OWNER within fifteen (15) days of the Notice of Award and receipt of Contract Documents by the Contractor for execution; and OWNER will execute and deliver one counterpart to Contractor within ten (10) days of receipt of the executed Agreement from Contractor.
- 2.01            Delivery of Bonds and Evidence of Insurance
- 2.01.B            Replace "Before any Work at the Site is started, Contractor and Owner shall each deliver to the other" with "When Contractor delivers the executed counterparts of the Agreement to the Owner, Contractor shall deliver to the Owner", and replace "and Owner respectively are" with "is".
- 2.03            Commencement of Contract Times; Notice To Proceed:
- 2.03.A            Delete in its entirety and substitute the following:
- 2.03.A            The Contract Time will commence to run on the day indicated in the Notice to Proceed; but in no event will the Contract Time commence to run later than the ninetieth day after the day of Bid opening or the thirtieth day after the effective date of the Agreement. By mutual consent of the parties to the Contract, these time limits may be changed.

## ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING AND REUSE

- 3.01            Intent:

Add the following:

- 3.01.D            It is the intent of the Specification and Contract Documents to obtain an operable Project. Equipment, components, systems, etc., therein shall be made operable by the Contractor.
- 3.01.E            The Contract Drawings may be supplemented from time to time with additional Drawings by the Engineer as may be required to illustrate the work or, as the work progresses, with additional Drawings, by the Contractor, subject to the approval of the Engineer. Supplementary Drawings, when issued by the Engineer or by the Contractor, after approval by the Engineer, shall be furnished in sufficient quantity to all those who, in the opinion of the Engineer, are affected by such Drawings.

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

4.02 Subsurface and Physical Conditions:

4.02.A Delete: "the Supplementary Conditions", and substitute "Section 01010 - SUMMARY OF WORK".

4.02.B Second sentence, delete: "Supplementary Conditions" and substitute "Specifications and Contract Drawings".

4.04 Underground Facilities:

Add the following:

4.04.B.3 The Owner, Engineer, and Engineer's Consultants shall not be liable to Contractor for any claims, costs, losses or damages incurred or sustained by Contractor on or in connection with any other project or anticipated project.

4.06 Hazardous Environmental Condition at Site

4.06.A First sentence, delete "Supplementary Conditions" and substitute "Section 01010 – SUMMARY OF WORK."

4.06.B Second sentence, delete "Supplementary Conditions: and substitute "Specifications and Contract Drawings."

ARTICLE 5 - BONDS AND INSURANCE

Delete Article 5 in its entirety and substitute the following:

5.01 Performance and Payment Bonds:

5.01.A Concurrent with execution of the Agreement and within fifteen (15) days of the Notice of Award, the successful Contractor shall procure, execute and deliver to the OWNER and maintain, at his own cost and expense, the following bonds, in the forms attached, of a surety company approved by the State of North Carolina as a Surety:

5.01.B Performance Bond - in an amount not less than 100% of the total amount payable to the Contractor by the terms of the Contract as security for the faithful performance of the work. Bond must be valid until one year after the date of issuance of the Certificate of Substantial Completion.

5.01.C Payment Bond - in an amount not less than 100% of the total amount payable to the Contractor by the terms of the Contract as security for the payment of all persons performing labor and furnishing material in connection with the work. Bond must be valid until one (1) year after date of issuance of the Certificate of Substantial Completion.

- 5.01.D All Bonds signed by an agent must be accompanied by a certified copy of the authority to act.
- 5.01.E If the Surety on any Bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to do business in the State of North Carolina is revoked, the Contractor shall within five (5) days thereafter substitute another Bond or Surety, both of which shall be acceptable to the OWNER.
- 5.02 Insurance Requirements:
- 5.02.A Wherever in this Article the terms "The Insured" and OWNER occurs with respect to coverage in a policy, it shall mean the OWNER and its agent and agencies, all municipalities where work is being performed under the Contract, the Engineer, and any other parties specifically designated herein, who shall be named as additional insured in each policy issued, except the Worker's Compensation and Employer's Liability policy. The insurance policies required herein shall not contain any Third Party Beneficiary Exclusion.
- 5.02.B The OWNER and the Engineer shall be named as an additional insured on all policies except Professional Liability and Worker's Compensation and Employer's Liability; and it is required that coverage be placed with "A" rated insurance companies acceptable to the OWNER. Statement should read "City of Havelock and Hazen and Sawyer shall be added as an additional insured as evidenced by an endorsement attached to this certificate." The endorsement must be written on ISO Form CG20-10 and 20-37. Blanket coverage for general liability in lieu of being named as an additional insured is acceptable. Failure to maintain the required insurance in force may be cause for contract termination. In the event that the Contractor fails to maintain and keep in force the insurance herein required, the OWNER has the right to cancel and terminate the contract without notice.
- 5.02.C The Contractor shall not commence work under the Contract until he has obtained all insurance required under this Article and such insurance has been approved by the OWNER, nor shall the Contractor allow any Subcontractor to commence work on his Subcontract until all similar insurance required of the Subcontractor has been so obtained and approved.
- 5.02.D Provision of some types of insurance by a Subcontractor may be waived, at the option of the OWNER, where it is deemed that adequate coverage is provided by the Contractor's insurance.
- 5.02.E Subcontractors must, in all cases, provide Workers' Compensation and Employer's Liability Insurance and Motor Vehicle Liability Insurance.
- 5.02.F An authorized representative of the insurance company(ies) shall certify that all of the required insurance coverages and amounts specified hereinafter are provided by the submitted policies. The certification shall be signed by the authorized representatives of the insurance company(ies) and notarized. The authorized representative of the insurance company(ies) shall specifically indicate with the submittal which of the policies submitted fulfills which specific coverage and amounts specified under Article 5.03 of the Supplementary Conditions. The certification statement and correlation shall be furnished and included with the insurance certificates.

5.02.G One (1) copy of each such insurance policy and certificates indicating each type of coverage mentioned, and the correlation between the insurance furnished and that required, shall be filed with each of the Insured.

5.02.H All policies relating to this Contract shall be so written that each of The Insured shall be notified by the carrier of cancellation or change at least thirty (30) days prior to the effective date of such cancellation or change. Renewal certificates covering the renewal of all policies expiring during the life of the Contract shall be filed with each of The Insured not less than sixty (60) days before the expiration of such policies.

5.02.I The insurance carrier shall notify each of The Insured of the filing of any claims within thirty (30) days of the filing of such claim.

### 5.03 Contractors Liability Insurance

5.03.A The Contractor shall, at his own cost, take out and maintain during the life of this Contract, such Bodily Injury and Property Damage Insurance as will protect him, The Insured, and any Subcontractor performing work covered by this Contract from claims of any character for property damage or bodily injury, including death, and demands, suits, actions, recoveries and judgments against The Insured therefor, for which The Insured shall be or may become liable; which may arise from operations under this Contract whether such operations be by himself or by a Subcontractor or by anyone directly or indirectly employed by either of them, and as will also cover the contingent liability of the Insured, if any, which may arise from said operations under this Contract. The Contractor may elect to require his Subcontractors to provide their own insurance coverage in lieu of covering them under his own policy(ies). In that event, the Contractor shall certify to the OWNER, in writing, that all of his Subcontractor's are insured to the coverage and amounts specified herein. The Contractor shall maintain copies of all Subcontractors' insurance certificates at the project site. The amounts of such insurance shall be as follows and shall apply per project:

5.03.B Bodily Injury Liability - For liability for bodily injury, including accidental or wrongful death:

1.	Contract No. , General Construction -	\$ 1,000,000 per occurrence
		\$ 5,000,000 aggregate
2.	Contract No. , Electrical Construction -	\$ 1,000,000 per occurrence
		\$ 5,000,000 aggregate
3.	Contract No. , HVAC Construction -	\$ 1,000,000 per occurrence
		\$ 5,000,000 aggregate
4.	Contract No. , Plumbing Construction -	\$ 1,000,000 per occurrence
		\$ 5,000,000 aggregate

5.03.C Property Damage Liability - For liability for property damage:

1.	Contract No. , General Construction -	\$ 1,000,000 per occurrence
		\$ 5,000,000 aggregate

- |    |  |   |
|----|--|---|
| 2. | Contract No. , Electrical Construction - | \$ 1,000,000 per occurrence<br>\$ 5,000,000 aggregate |
| 3. | Contract No. , HVAC Construction -       | \$ 1,000,000 per occurrence<br>\$ 5,000,000 aggregate |
| 4. | Contract No. , Plumbing Construction -   | \$ 1,000,000 per occurrence<br>\$ 5,000,000 aggregate |

5.03.D Excess Liability (Umbrella Liability Insurance) – Umbrella Liability Insurance shall be provided that provides additional coverage for all protection provided under the Contractor's Commercial General Liability insurance. The coverage limit shall be for the Umbrella Liability Insurance shall be as follows:

Umbrella Liability Insurance      \$5,000,000

- 5.03.E
1. Fire and Extended Coverage - For fire and extended coverage, including vandalism and malicious mischief, total Bid Price of the Contract.
  2. Insurance policies shall provide for reinstatement of full coverage after payment of any claim.

5.03.F The following types of insurance shall be provided:

1. Workers' Compensation and Employer's Liability Insurance. The Contractor shall take out and maintain during the life of this Contract, Workers' Compensation and Employer's Liability Insurance for all of his employees, employees employed at the site, and in case any work is sublet, the Contractor shall require the Subcontractor similarly to provide Workers' Compensation and Employer's Liability Insurance for all employees of the latter unless such employees are covered by the protection afforded by the Contractor.
2. Contractor's Bodily Injury Insurance - Liability for Contractor's Bodily Injury Insurance shall be in the amounts specified. .
3. OWNER'S and Contractor's Protective Bodily Injury Insurance - Liability for OWNER'S and Contractor's Protective Bodily Injury Insurance shall be \$1,000,000 per occurrence and \$5,000,000 aggregate.
4. Contractor's Contractual Bodily Injury Insurance - Liability for Contractor's Contractual Bodily Injury Insurance shall be in the amounts specified.
5. Contractor's Property Damage Insurance - Liability for Contractor's Property Damage Insurance shall be in the amounts specified.
6. OWNER'S and Contractor's Protective Property Damage Insurance - Liability for OWNER'S and Contractor's Protective Property Damage Insurance shall be \$1,000,000 per occurrence and \$5,000,000 aggregate.



7. Contractor's Contractual Property Damage Insurance - Liability for Contractor's Contractual Property Damage Insurance shall be in the amounts specified.
8. Motor Vehicle Liability Insurance:
  - a. Bodily Injury Insurance covering the operation of all motor vehicles owned by the Contractor, or used by the Contractor in the prosecution of the work under the Contract, shall be in the amounts specified in Paragraph 5.03.B, hereinbefore.
  - b. Property Damage Insurance covering the operation of all motor vehicles owned by the Contractor, or used by the Contractor in the prosecution of the work under the Contract, shall be in the amounts specified in Paragraph 5.03.C, hereinbefore.
9. Special Hazards Insurance - Bodily injury and property damage insurance shall be in the amount specified in Paragraphs 5.03.B and 5.03.C, hereinbefore when bodily injury and property damage results from the following special hazards:
  - a. Blasting and explosion;
  - b. Collapse of or structural injury to any structure due to the Contractor's operations;
  - c. Damage to underground structures, pipes or conduits.
10. OWNER'S Fire and Extended Coverage Insurance - Builder's Risk (fire and extended coverage, including vandalism and malicious mischief) insurance for the life of the Contract upon all work in place, or materials at the site, or both, shall be in the amount specified in Paragraph 5.03.D, hereinbefore. The Contractor shall submit to the OWNER documentation as to the cost of this insurance coverage prior to obtaining policy. The OWNER may, if deemed to be in his best interest, obtain this coverage separately and receive a credit from the Contractor for the insurance cost.
11. Completed Operations Hazards Insurance - Completed operations hazards insurance is to be provided for all the named insured in the greater of the amounts set forth in Paragraph 5.03.B, 5.03.C, and 5.03.D hereinbefore. The intent of this Section is to provide coverage to all of the named insureds, for the period of the applicable statute of limitation, for any and all claims which may arise from operations under this Contract.

5.03.F If any of the property and casualty insurance requirements are not complied with at their renewal dates, payments to the Contractor will be withheld until these requirements have been met, or at the option of the OWNER, the OWNER may pay the renewal premiums and withhold such payments from any monies due to the Contractor.

5.03.G In the event that claims in excess of the insured amounts provided herein are filed by reason of any operations under the Contract, the amount of excess of such

claims, or any portion thereof, may be withheld from payment due or to become due the Contractor until such time as the Contractor shall furnish such additional security covering such claims as may be determined by the OWNER.

5.03.H All policies and certificates of insurance of the Contractor shall contain the following clauses:

1. Insurers shall have no right of recovery or subrogation against the OWNER and its agents and agencies and the Engineer, it being the intention of the parties that the insurance policies so effected shall protect both parties and be primary coverage for any and all losses covered by the above described insurance.
2. The clause "other insurance provisions" in a policy in which the OWNER and its agents and agencies and the Engineer is named as an insured, shall not apply to these parties.
3. The insurance companies issuing the policy or policies shall have no recourse against the OWNER and its agents and agencies and the Engineer, for the payment of any premiums or for assessments under any form of policy.
4. Any and all deductibles in the above described insurance policies shall be assumed by and be for the amount of, and at the sole risk of the Contractor.

5.04 Indemnification Agreement:

5.04.A Indemnification - To the fullest extent permitted by law, Contractor shall indemnify and hold harmless OWNER and Engineer and their agents, Subconsultants and employees from and against all claims, damages, losses and expenses including but not limited to attorneys' fees arising out of or resulting from the performance of the Work, provided that any such claim, damage, loss or expense (a) is attributable to bodily injury, sickness, disease or death, or to injury or to destruction of tangible property (other than Work itself) including the loss of use resulting therefrom (b) is caused in whole or in part by either (1) any negligent act or omission of Contractor, any Subcontractor, anyone directly or indirectly employed by any of them may be liable regardless of whether or not a party indemnified hereunder is partially negligent or (2) arises out of operation of law as a consequence of any act or omission of the Contractor, and Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, regardless of whether any of them has been negligent; provided however that no party shall be entitled to indemnification with respect to such party's own negligence. This provision is intended to indemnify to the fullest extent permitted by law both OWNER and Engineer independently of the negligence of the other and thus the OWNER'S negligence shall not preclude indemnification by Contractor of the Engineer, and Engineer's negligence shall not preclude indemnification by Contractor of OWNER.

## ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

- 6.06 Concerning Subcontractors, Suppliers and Others:
- 6.06.B First sentence, delete: "If the Supplementary Conditions", and substitute "The Instructions to Bidders". The seventh line, delete: "Supplementary Conditions", and substitute "Instructions to Bidders".
- 6.06.G Delete in its entirety and substitute the following:
- 6.06.G All work performed for Contractor by a Subcontractor shall be pursuant to an appropriate agreement between the Contractor and Subcontractor. The Subcontractor shall not commence work until the Contractor has obtained all insurance as required by Paragraphs 5.02 through 5.03 inclusive.
- 6.07 Patent Fees and Royalties:
- 6.07 Delete 6.07.A, 6.07.B, and 6.07.C in their entirety and substitute the following:
- 6.07.A Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work of any invention, design, process, products or device which is the subject of patent rights or copyrights held by others. Contractor shall indemnify and hold harmless OWNER and Engineer and anyone directly or indirectly employed by either of them from and against all claims, damages, losses and expenses, including attorney's fees, arising out of any infringement of patent rights or copyrights incident to the use in the performance of the Work or furnished by him in fulfillment of the requirements of this Contract. In the event of any claim or action by law on account of such patents or fees, it is agreed that the OWNER may retain out of the monies which are or which may become due the Contractor under this Contract, a sum of money sufficient to protect itself against loss, and to retain the same until said claims are paid or are satisfactorily adjusted.
- 6.08 Permits:
- 6.08.A Third sentence of paragraph delete, "or if there are no Bids.....to the Work.", and substitute "and the Contractor shall pay all charges of utility owners for connections to the Work."
- 6.09 Laws and Regulations:
- 6.09.B Delete 6.09.B in its entirety and substitute the following:
- 6.09.B If Contractor observes that the Specifications or Drawings are at variance with any Laws or Regulations, he shall give Engineer prompt written notice thereof. If Contractor performs any Work knowing it to be contrary to such Laws or Regulations, and without such notice to Engineer, he shall bear all costs arising therefrom. The Contractor shall, at all times, observe and comply with and shall cause all his agents and employees and all his Subcontractors to observe and comply with all such existing Laws or Regulations, and shall protect and indemnify the OWNER and the Engineer and the municipalities in which work is being performed, and their officers and agents against any claim, civil penalty, fine or liability arising from or based on the violation of any such Law or Regulation, whether by himself or his employees or any of his Subcontractors.

6.10 Taxes:

Add the following:

6.10.B PROCEDURES FOR REPORTING NORTH CAROLINA SALES TAX EXPENDITURES

6.10.B.1 The following procedure in handling the North Carolina Sales Tax is applicable to this Project. Contractors shall comply fully with the requirements outlined hereinafter, in order that the OWNER may recover the amount of tax permitted under the law.

- 6.10.B.2
- (a) It shall be the Contractor's responsibility to furnish the OWNER documentary evidence showing the materials used and sales tax paid by the Contractor and each of his Subcontractors with each payment request in a format approved by the OWNER.
  - (b) The documentary evidence shall consist of a certified statement, by the Contractor and each of his Subcontractors individually, showing total purchases of materials from each separate vendor and total sales taxes paid each vendor. Certified statements must show the invoice number or numbers, covered and inclusive dates of such invoices.
  - (c) Materials used from the Contractor's or Subcontractor's warehouse stock shall be shown in a certified statement at warehouse stock prices.
  - (d) The Contractor shall not be required to certify the Subcontractor's statements.
  - (e) The documentary evidence to be furnished to OWNERS eligible for sales or use tax refunds covers sales and/or use taxes paid on building materials used by Contractors and Subcontractors in the performance of Contracts with churches, orphanages, hospitals not operated for profit and other charitable or religious institutions or organizations not operated for profit and, incorporated cities, towns, and counties in this State. The documentary evidence is to be submitted to the above-named institutions, organizations and governmental units to be included in claims for refunds to be prepared and submitted by them to obtain refunds provided by G.S. 105-164.14(2) and (3) of the 1961 Statute, and is to include the purchases of building materials, supplies, fixtures, and equipment which become a part of or annex to buildings or structures being erected, altered or repaired under Contracts with such institutions, organizations or governmental units.

6.13 Safety and Protection:

6.13.B First sentence, after "CONTRACTOR" add the following:

", subject to provisions 6.09.B,"

6.19 Contractor's General Warranty and Guarantee:

- 6.19.A After the first sentence of Section 6.19.A add the following:
- "All materials or equipment delivered to the site shall be accompanied by certificates, signed by an authorized officer of the supplier, and notarized guaranteeing that the materials or equipment conform to specification requirements. Such certificates shall be immediately turned over to the Engineer. Materials or equipment delivered to the site without such certificates will be subject to rejection."
- 6.20 Indemnification:
- 6.20.A First sentence, after "...claims, costs" add the following:
- ", civil penalties, fines,"
- 6.20.C Add the following:
- 6.20.C.3 Nothing in the Contract Documents shall create or give to third parties any claim or right of action against the Contractor, the OWNER or the Engineer beyond such as may legally exist irrespective of the Contract.

#### ARTICLE 7 - OTHER WORK AT THE SITE

- 7.02 Coordination:
- Delete in its entirety.
- 7.03 Legal Relationships
- 7.03.B Delete "Owner and".
- 7.03.C Delete "Owner and".

#### ARTICLE 8 - OWNER'S RESPONSIBILITIES

- 8.02 Replacement of Engineer
- 8.02.A Delete in its entirety.
- 8.06 Insurance
- 8.06.A Delete in its entirety.
- 8.11 Evidence of Financial Arrangements
- 8.11.A Delete in its entirety.

#### ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

- 9.01 OWNER'S Representative:
- 9.01.A Delete in its entirety and substitute the following:
- 9.01.A Engineer will be the OWNER'S representative during the construction period, and his instructions shall be carried into effect promptly and efficiently.
- 9.02 Visits to the Site:
- 9.02.A Delete in its entirety.
- 9.03 Project Representative:

Add the following:

- 9.03.B The Resident Project Representative will serve as the Engineer's liaison with the Contractor, working principally through the Contractor's resident superintendent to assist him in understanding the intent of the Contract Documents.
- 9.03.C The Resident Project Representative shall conduct on-site observations of the work in progress to confirm that the work is proceeding in accordance with the Contract Documents. He will verify that tests, equipment and systems start-ups and operating and maintenance instructions are conducted as required by the Contract Documents. He will have the authority to disapprove or reject defective work in accordance with Article 13.
- 9.09 Limitations on Engineer's Authority and Responsibilities:

Add the following:

- 9.09.F Except upon written instructions of the Engineer, the Resident Project Representative:
1. Shall not authorize any deviation from the Contract Documents or approve any substitute materials or equipment.
  2. Shall not exceed limitations of Engineer's authority as set forth in the Contract Documents.
  3. Shall not undertake any of the responsibilities of Contractor, Subcontractors or Contractor's superintendent, or expedite the Work.
  4. Shall not advise on or issue directions relative to any aspect of the means, methods, techniques, sequences or procedures of construction unless such is specifically called for in the Contract.
  5. Shall not advise on or issue directions as to safety precautions and programs in connection with the Work.

#### ARTICLE 11 – COST OF THE WORK; CASH ALLOWANCES, UNIT PRICE WORK

- 11.01 Cost of the Work:
- 11.01.A.1 Last sentence, following "...in Paragraph 11.01.B," insert the following:
- "or claims for extra cost shall be considered based on an escalation of labor costs throughout the period the Contract,"
- 11.01.A.2 Add the following at the end of the paragraph:
- "No claims for extra cost shall be considered based on an escalation of material costs throughout the period of the Contract."
- 11.01.A.3 Delete second sentence "If required ... be acceptable."
- 11.01.A.4 Delete in its entirety.
- 11.01.A.5.a Delete in its entirety.
- 11.01.A.5.c Add the following before last sentence of paragraph:
- "These rates shall include all fuel, lubricants, insurance, etc. Equipment rental charges shall not exceed the prorated monthly rental rates listed in the current edition of the 'Compilation' of Rental Rates for Construction Equipment" as published by the Associated Equipment Distributors. Charges per hour shall be determined by dividing the monthly rates by 176."
- 11.01.A.5.f Delete in its entirety.
- 11.01.A.5.g Delete in its entirety.
- 11.01.A.5.h Delete in its entirety.
- 11.03 Unit Price Work
- 11.03.D.1 Delete "materially and significantly", and insert "by more than plus or minus twenty percent (20%)".

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

- 12.03 Delays
- 12.03.B Delete in its entirety and substitute the following:
- 12.03.B Delays beyond the control of the Contractor, as provided in paragraph 12.03.A, shall not entitle the Contractor to obtain additional project overhead costs unless such delays extend the Project as described below:
1. beyond the original Contract Times,
  2. beyond the Contract Times for which the overhead costs have been previously approved, or

3. beyond Contract Times that are extended as a result of delays described in 12.03.C.



For the purpose of this paragraph, overhead costs shall be the supplemental costs defined in 11.01.A.5, paragraphs a,b,c,g,h and i. The Contractor's bid shall include all overhead costs as necessary to be on the Project for the original Contract Times.

12.03.C Add the following after the last sentence:

Delays described in this Paragraph 12.03.C shall be determined as follows:

1. Contractor shall obtain weather history for the most recent five (5) years (minimum) preceding the Bid date. Weather history shall be obtained from the National Oceanic & Atmospheric Administration (NOAA) or other source approved by the Engineer. Historical weather shall be based on data from the weather reporting station closest to the project site.
2. For delays associated with an abnormal amount of rain, the Contractor shall use the weather history to calculate an average number of days that rainfall exceeded 0.1-inches for the period (month, quarter, year, etc.) in question. The average value calculated shall be rounded up to the next full day. The Contractor will be awarded a time extension equal to the number of days, above the calculated average, that the period in question experienced rainfall in excess of 0.1- inches. A Contract Time extension will not be awarded for rain amounts less than 0.1-inches.
3. For daily rain amounts in excess of 1-inch the Contractor shall be awarded one day beyond the number of days calculated as described above. The added day shall be a recovery period for the Contractor to perform site maintenance, to dewater the site and to restore erosion control facilities before resuming work.
4. For delays associated with other abnormal weather events, the weather history shall be used to calculate an average number of days for the type of weather considered to be the cause of a delay. (Calculation of the average number of days shall be as described above.) The Contractor will be awarded a time extension equal to the number of days beyond the calculated average for the period in question. Where the Contractor can demonstrate that the abnormal weather event has impaired his ability to perform work, beyond the day of the abnormal event, a recovery day, or days, to perform site maintenance as necessary to restore the site to a workable condition may be awarded. The recovery days may be awarded if requested in writing by the Contractor and approved by the Engineer. Written requests for recovery days shall include a description of work activities performed during the recovery days.

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

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13.03 Tests and Inspections:

13.03.B Delete in its entirety and substitute the following:

13.03.B OWNER shall employ and pay for inspections and testing services specifically noted as such in the Contract. All others required shall be the responsibility of the Contractor.

13.03.C Delete in its entirety and substitute the following:

13.03.C If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to be specifically inspected, tested, or approved by some public body, Contractor shall assume full responsibility therefore, pay all costs in connection therewith and furnish Engineer the required certificates of inspection, testing or approval.

Add the following:

13.03.G The OWNER reserves the right to independently perform at its own expense, laboratory tests on random samples of material or performance tests on equipment delivered to the site. These tests if made will be conducted in accordance with the appropriate referenced standards or Specification requirements. The entire shipment represented by a given sample, samples or piece of equipment may be rejected on the basis of the failure of samples or pieces of equipment to meet specified test requirements. All rejected materials or equipment shall be removed from the site, whether stored or installed in the Work, and the required replacement shall be made, all at no additional cost to the OWNER.

13.05 OWNER May Stop the Work:

13.05.A First sentence, after "...conform to the Contract Documents", insert "or if the Work interferes with the operation of the existing facility".

13.06 Correction or Removal of Defective Work:

Add the following:

13.06.C At any time during the progress of the Work and up to the date of final acceptance, the Engineer shall have the right to reject any work which does not conform to the requirements of the Contract Documents, even though such work has been previously inspected and paid for. Any omissions or failure on the part of the Engineer to disapprove or reject any Work or materials at the time of inspection shall not be construed as an acceptance of any defective work or materials.

## ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

### 14.01 Schedule of Values:

Add the following:

14.01.B The Contractor shall submit for the Engineer's approval, a complete breakdown of all Lump Sum Items in the Proposal. This breakdown, modified as directed by the Engineer, will be used as a basis for preparing estimates and establishing progress payments.

14.01.C A Lump Sum Payment equal to 1-1/2% of the total Bid Price (to include all bonds, insurance, move-on expenses, etc.) will be allowed for 'mobilization' as a progress payment line item. The actual cost of bonds and insurance (up to the maximum payment of 1-1/2%) will be considered in the initial payment request provided that cost documentation suitable to the Engineer is furnished by the Contractor. Any outstanding balance of the mobilization line item will be payable when the Project work is 10% complete as indicated by the approved progress payments (less cost of mobilization and stored equipment).

### 14.02 Progress Payments:

14.02.A.3 Delete in its entirety and replace with the following:

14.02.A.3 Progress payment request shall include the percentage of the total amount of the Contract which has been completed from the start-up of the Project to and including the last day of the preceding month, or other mutually agreed upon day of the month accompanied by such data and supporting evidence as OWNER or Engineer may require.

Add the following:

14.02.A.4 Forms to be used shall be prepared by the Contractor and submitted to the Engineer for approval.

14.02.A.5 At the option of the OWNER, partial payment up to the estimated value, less retainage, may be allowed for any materials and equipment not incorporated in the Work, pursuant to the following conditions:

- a. Major equipment items stored off site shall be stored in a bonded warehouse and properly maintained during storage.
- b. Equipment or materials stored on the site shall be properly stored, protected and maintained.
- c. For any partial payment the Contractor shall submit, with his monthly progress payment from each material or equipment manufacturer, bills or invoices indicating actual material cost.
- d. Contractor shall submit evidence that he has paid for materials or equipment stored and for which the Engineer has authorized partial

payment and previous progress payments, prior to submission of the next monthly payment request.

- 14.02.A.6 The OWNER will retain five percent (5%) of the amount of each such estimate until Work covered by the Contract is fifty percent (50%) complete. When fifty percent (50%) of the Work of the original Contract has been completed and in the opinion of the OWNER the Contractor continues to perform satisfactorily and nonconforming work identified in writing prior to that time by the Engineer or OWNER has been corrected by the Contractor and accepted by the OWNER, the OWNER with written consent of surety will adjust future partial payments so that two and one-half percent (2-1/2%) of the original Contract Price is retained. The project shall be deemed fifty percent (50%) complete when the contractor's gross project invoices, excluding the value of materials stored off-site, equal or exceed fifty percent (50%) of the original value of the contract, except the value of materials stored on-site shall not exceed twenty percent (20%) of the contractor's gross project invoices for the purpose of determining whether the project is fifty percent (50%) complete.
- 14.02.A.7 If the OWNER determines it is appropriate to reduce retainage, the method used for such adjustment shall be to fix retainage at two and one-half percent (2-1/2%) of the original Contract amount (when the work is 50% complete) and to pay all subsequent Partial Payment Requests to the full approved amount. The intent of such an adjustment is to gradually reduce retainage to two and one-half percent (2-1/2%) of the original Contract amount when the work is one hundred percent (100%) complete. Following 50% completion of the project, the Owner may also withhold additional retainage from any subsequent periodic payment, not to exceed five percent (5%), in order to allow the Owner to retain two and one-half percent (2-1/2%) total retainage through the completion of the project.
- 14.02.A.8 If the OWNER determines the Contractor's performance is unsatisfactory, the OWNER may reinstate retainage for each subsequent periodic payment application up to a maximum amount of five (5) percent of the original Contract amount.
- 14.02.A.9 Within sixty (60) days after the submission of a final pay request, the OWNER with written consent of the surety shall release to the Contractor all retainage on payments held by the OWNER if (1) the OWNER receives a certificate of substantial completion from the ENGINEER; or (2) the OWNER receives beneficial occupancy or use of the project. However, the OWNER may retain sufficient funds to secure completion of the project or corrections on any work. If the OWNER retains funds, the amount retained shall not exceed two and one-half times (2-1/2) the estimated value of the work to be completed or corrected. Any reduction in the amount of the retainage on payments shall be with the written consent of the Contractor's surety.
- 14.02.A.10 Retainer provisions contained in Contractor's subcontracts may not exceed the terms and conditions for retainage provided herein. Contractors are further required to satisfy the retainage provisions of N.C.G.S. 143-134.1(b2) with regard to subcontracts for early finishing trades (structural steel, piling, caisson, and demolition) and to coordinate the release of retainage for such trades from the retainage held by the OWNER from the Contractor pursuant to statute.

- 14.02.A.11 Nothing shall prevent the OWNER from withholding payment to the Contractor in addition to the amounts identified herein for unsatisfactory job progress, defective construction not remedied, disputed work, or third-party claims filed against the OWNER or reasonable evidence that a third-party claim will be filed.
- 14.02.B.1 Review of Applications:  
  
First sentence, delete "10 days", insert "30 days".
- 14.02.D.3 Delete "as provided in the Agreement" and replace with "equal to the federal funds rate as established from time to time by the Federal Open Market Committee of the United States Federal Reserve."
- 14.04 Substantial Completion:
- 14.04 Delete paragraphs A, B, C and D in their entirety and substitute the following:
- 14.04.A Contractor may, in writing to OWNER and Engineer, certify that the entire Project is substantially complete and request that Engineer issue a certificate of Substantial Completion. Within a reasonable time thereafter, OWNER, Contractor and Engineer shall make an inspection of the Project to determine the status of completion. If Engineer and OWNER do not consider the Project substantially complete, Engineer will notify Contractor in writing giving his reasons therefor. If Engineer and OWNER consider the Project substantially complete, Engineer will prepare and deliver to OWNER a tentative certificate of Substantial Completion and the responsibilities between OWNER and Contractor for maintenance, heat and utilities. There shall be attached to the certificate a tentative list of items to be completed or corrected before Substantial Completion, and the certificate shall fix the time within which such items shall be completed or corrected, said time to be within Contract Time.
- 14.05 Partial Utilization:
- 14.05.A Delete in its entirety and substitute the following:
- 14.05.A Prior to Substantial Completion of the Project, OWNER may request Contractor in writing to permit him to use a specified part of the Project which he believes he may use without significant interference with construction of the other parts of the Project. If Contractor agrees, he will certify to OWNER and Engineer that said part of the Project is substantially complete and request the Engineer to issue a certificate of Substantial Completion for that part of the Project. Within a reasonable time thereafter, OWNER, Contractor and Engineer shall make an inspection of that part of the Project to determine its status of completion. If Engineer and OWNER do not consider that it is substantially complete, Engineer will notify Contractor in writing giving his reasons therefor. If Engineer and OWNER consider that part of the Project to be substantially complete, Engineer will execute and deliver to OWNER and Contractor a certificate to that effect, fixing the date of Substantial Completion as to that part of the Project, attaching thereto a tentative list of items to be completed or corrected before Substantial Completion of the entire Project and fixing the responsibility between OWNER and Contractor for Maintenance, heat, and utilities as to that part of the Project. OWNER shall have the right to exclude Contractor from any part of the Project

which Engineer has so certified to be substantially complete, but OWNER shall allow Contractor reasonable access to complete items on the tentative list.

#### ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

##### 15.01 Owner May Suspend Work

Add the following:

15.01.B Should the OWNER suspend Work due to repeated unsafe Work conducted by the CONTRACTOR which is confirmed by subsequent inspection by OSHA, the CONTRACTOR shall not be allowed any adjustment in Contract Price or extension of Contract Time attributed to this delay.

##### 15.02 Owner May Terminate for Cause

15.02.A.2 Add the following to the end of first sentence after "jurisdiction":

"(including those governing employee safety)"

15.02.D Delete in its entirety.

Add the following:

##### 15.05 Assignment of Contract:

15.05.A Contractor shall not assign, transfer, convey or otherwise dispose of the Contract, or of his legal right, title, or interest in or to the same or to any part thereof, without the prior written consent of the OWNER. Contractor shall not assign by power of attorney or otherwise any monies due him and payable under this Contract without the prior written consent of the OWNER. Such consent, if given, will in no way relieve the Contractor from any of the obligations of this Contract. OWNER shall not be bound to abide by or observe the requirements of any such assignment.

#### ARTICLE 16 - DISPUTE RESOLUTION

##### 16.01 Methods and Procedures

16.01.A Replace the first sentence with the following:

"If required by applicable laws and regulations, and not specifically excluded elsewhere, either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding."

## ARTICLE 17 - MISCELLANEOUS

### 17.01 Giving Notice:

Add the following:

- 17.01.B No oral statement of any person whomsoever shall in any manner or degree modify or otherwise affect the terms of this Contract. Any notice to the Contractor, from OWNER and Engineer, relative to any part of this Contract shall be in writing.

Add the following:

## ARTICLE 18 - LIQUIDATED DAMAGES FOR FAILURE TO COMPLETE WORK ON TIME

### 18.01 Liquidated Damages

- 18.01.A If the Contractor shall fail to complete the Work within the Contract Time, or extension of time granted by the OWNER in accordance with Article 12, then the Contractor will pay to the OWNER the amount for liquidated damages as specified in the Contract for each calendar day that the Contractor shall be in default after the time stipulated in the Contract Documents.
- 18.01.B The Contractor shall not be charged with liquidated damages or any excess cost when delay in completion of the Work is due to the following and the Contractor has promptly given written notice of such delay to the OWNER or Engineer:
- 18.01.C To any preference, priority or allocation order duly issued by the OWNER.
- 18.01.D To unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to, acts of God, or of the public enemy, acts of the OWNER, acts of another Contractor in the performance of a contract with the OWNER, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes; and abnormal and unforeseeable weather; and
- 18.01.E To any delays of Subcontractors occasioned by any of the causes specified in Paragraphs 18.01.C and 18.01.D of this Article.

**\* \* \* PUT ON CONTRACTOR'S LETTERHEAD \* \* \***

**DATE:** \_\_\_\_\_

**TO: OWNER:** \_\_\_\_\_

**ADDRESS:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**RE:** Project \_\_\_\_\_  
Title \_\_\_\_\_  
Contract No. \_\_\_\_\_

We hereby certify that the labor and materials listed on this request for payment have been used in the construction of this work, or that all materials included in this request for payment and not yet incorporated into the construction are now on the site or stored at an approved location with proper insurance to protect these stored materials; and that all lawful charges for labor, materials, etc., covered by previous Certificates of Payment have been paid and that all other lawful charges on which this request for payment is based have been paid for in full or will be paid for in full from the funds received in payment of this request within ten (10) calendar days from receipt of this partial payment from the OWNER.

**CONTRACTOR:** \_\_\_\_\_  
**BY:** \_\_\_\_\_  
**TIME:** \_\_\_\_\_

State of \_\_\_\_\_  
County of \_\_\_\_\_

Sworn to and subscribed before me this \_\_\_\_\_ day of \_\_\_\_\_  
20 \_\_\_\_ .

\_\_\_\_\_  
Notary Public (Seal)

My Commission expires \_\_\_\_\_ .

- END OF SECTION -



SECTION 01010  
SUMMARY OF WORK

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Work to be done under these Contracts and in accordance with these Specifications consists of furnishing all equipment, superintendence, labor, skill, material and all other items necessary for the construction of the Macdonald Downs Pump Station. The Contractor shall perform all work required for such construction in accordance with the Contract Documents and subject to the terms and conditions of the Contract, complete and ready for use.
- B. The principal features of the Work to be performed under these Contracts includes:
  - 1. SINGLE PRIME CONTRACT: The scope of this work includes the construction of a submersible pump station in a precast 10 ft. diameter manhole, a check valve vault, and piping connecting pump station to existing manhole. A standby generator will also be provided. The pump station will have two new submersible pumps with plans of another future pump. Electrical work includes a new electrical rack with pump control panel, mini power center and disconnect switch; all new conduit from pump station to control panel. The scope also includes approximately 300 linear feet of gravity sewer and associated manholes from the existing pump station to the new pump station and the demolition of the existing station.
- C. The foregoing description(s) shall not be construed as a complete description of all work required.

1.02 CONTRACT DOCUMENTS

- A. The Work to be done is shown on the set of Drawings entitled MacDonald Downs Pump Station and dated September, 2017. The numbers and titles of all Drawings appear on the index sheet of the Drawings, Drawing X1. All drawings so enumerated shall be considered an integral part of the Contract Documents as defined herein.
- B. Certain Document Sections refer to Divisions of the Contract Specifications. Sections are each individually numbered portions of the Specifications (numerically) such as 08110, 13182, 15206, etc. The term Division is used as a convenience term meaning all Sections within a numerical grouping. Division 16 would thus include Sections 16000 through 16902.
- C. Where references in the Contract Documents are made to Contractors for specific disciplines of work (i.e. Electrical Contractor, etc.), these references shall be interpreted to be the single prime Contractor when the project is bid or awarded as a single prime contract.

1.03 GENERAL ARRANGEMENT

- A. Drawings indicate the extent and general arrangement of the work. If any departures from the Drawings are deemed necessary by the Contractor to accommodate the materials and equipment he proposes to furnish, details of such departures and reasons therefore shall be

submitted as soon as practicable to the Engineer for approval. No such departures shall be made without the prior written approval of the Engineer. Approved changes shall be made without additional cost to the Owner for this work or related work under other Contracts of the Project.

- B. The specific equipment proposed for use by the Contractor on the project may require changes, in structures, auxiliary equipment, piping, electrical, mechanical, controls or other work to provide a complete satisfactory operating installation. The Contractor shall submit to the Engineer, for approval, all necessary Drawings and details showing such changes to verify conformance with the overall project structural and architectural requirements and overall project operating performance. The Bid Price shall include all costs in connection with the preparation of new drawings and details and all changes to construction work to accommodate the proposed equipment, including increases in the costs of other Contracts.

#### 1.04 CONSTRUCTION PERMITS, EASEMENTS AND ENCROACHMENTS

- A. The Owner shall obtain or cause to be obtained all permanent and temporary construction easements as shown on the Drawings.
- B. The Contractor shall obtain, keep current and pay all fees for any necessary construction permits from those authorities, agencies, or municipalities having jurisdiction over land areas, utilities, or structures which are located within the Contract limits and which will be occupied, encountered, used, or temporarily interrupted by the Contractor's operations unless otherwise stated. Record copies of all permits shall be furnished to the Engineer.
- C. When construction permits are accompanied by regulations or requirements issued by a particular authority, agency or municipality, it shall be the Contractor's responsibility to familiarize himself and comply with such regulations or requirements as they apply to his operations on this Project.

#### 1.05 ADDITIONAL ENGINEERING SERVICES

- A. In the event that the Engineer is required to provide additional engineering services as a result of substitution of materials or equipment which are not "or equal" by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the Owner.
- B. Structural design shown on the Contract Drawings is based upon typical weights for major items of equipment as indicated on the Contract Drawings and specified. If the equipment furnished exceeds the weights of said equipment, the Contractor shall assume the responsibility for all costs of redesign and for any construction changes required to accommodate the equipment furnished, including the Engineer's expenses in connection therewith.
- C. In the event that the Engineer is required to provide additional engineering services as a result of Contractor's errors, omissions, or failure to conform to the requirements of the Contract Documents, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the Owner.

#### 1.06 ADDITIONAL OWNER'S EXPENSES

- A. In the event the Work of this Contract is not completed within the time set forth in the Contract or within the time to which such completion may have been extended in accordance with the Contract Documents, the additional engineering or inspection charges incurred by the Owner may be charged to the Contractor and deducted from the monies due him. Extra work or supplemental Contract work added to the original Contract, as well as extenuating circumstances beyond the control of the Contractor, will be given due consideration by the Owner before assessing engineering and inspection charges against the Contractor.
- B. Unless otherwise specifically permitted, the normal time of work under this Contract is limited to 8 hours per day, Monday through Friday. Work beyond these hours will result in additional expense to the Owner. Any expenses and/or damages, including the cost of the Engineer's on site personnel, arising from the Contractor's operations beyond the hours and days specified above shall be borne by the Contractor.
- C. Charges assessed to the Contractor for additional engineering and inspection costs will be determined based on actual hours charged to the job by the Engineer. Daily rates will depend on the number and classifications of employees involved, but in no case shall such charges exceed \$1000 per day for field personnel and \$1400 per day for engineering personnel, based on an eight hour workday.
- D. Charges for additional Owner's expenses shall be in addition to any liquidated damages assessed in accordance with the Contract.

#### 1.07 TIME OF WORK

- A. The normal time of work for this Contract is limited to 40 hours per week and shall generally be between the hours of 7:00 a.m. and 6:00 p.m., Monday through Friday. The Contractor may elect to work beyond these hours or on weekends provided that all costs incurred by the Owner for additional engineering shall be borne by the Contractor.
  - 1. The Owner shall deduct the cost of additional engineering costs from monies due the Contractor.
- B. If it shall become imperative to perform work at night, the Owner and Engineer shall be informed a reasonable time in advance of the beginning of such work. Temporary lighting and all other necessary facilities for performing and inspecting the work shall be provided and maintained by the Contractor.
- C. Unless otherwise specifically permitted, all work that would be subject to damage shall be stopped during inclement, stormy or freezing weather. Only such work as will not suffer injury to workmanship or materials will be permitted. Contractor shall carefully protect his work against damage or injury from the weather, and when work is permitted during freezing weather, he shall provide and maintain approved facilities for heating the materials and for protecting the finished work.

#### 1.08 SURVEYS AND LAYOUT

- A. All work under this Contract shall be constructed in accordance with the lines and grades shown on the Drawings or as directed by the Engineer. Elevation of existing ground and appurtenances are believed to be reasonably correct but are not guaranteed to be absolute and therefore are presented only as an approximation. Any error or apparent discrepancy in

the data shown or omissions of data required for accurately accomplishing the stake out survey shall be referred immediately to the Engineer for interpretation or correction.

- B. All survey work for construction control purposes shall be made by the Contractor at his expense. The Contractor shall provide a Licensed Surveyor as Chief of Party, competently qualified men, all necessary instruments, stakes, and other material to perform the work.
- C. Contractor shall establish all baselines for the location of the principal component parts of the work together with a suitable number of bench marks and batter boards adjacent to the work. Based upon the information provided by the Contract Drawings, the Contractor shall develop and make all detail surveys necessary for construction, including slope stakes, batter boards, stakes for all working points, lines and elevations.
- D. Contractor shall have the responsibility to carefully preserve the bench marks, reference points and stakes, and in the case of destruction thereof by the Contractor or resulting from his negligence, the Contractor shall be charged with the expense and damage resulting therefrom and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such bench marks, reference points and stakes.
- E. Existing or new control points, property markers and monuments that will be or are destroyed during the normal causes of construction shall be reestablished by the Contractor and all reference ties recorded therefore shall be furnished to the Engineer. All computations necessary to establish the exact position of the work shall be made and preserved by the Contractor.
- F. The Engineer may check all or any portion of the work and the Contractor shall afford all necessary assistance to the Engineer in carrying out such checks. Any necessary corrections to the work shall be immediately made by the Contractor. Such checking by the Engineer shall not relieve the Contractor of any responsibilities for the accuracy or completeness of his work.
- G. At completion of the work, the Contractor shall furnish Record Drawings indicating the final layout of all structures, roads, all structures, existing bench marks, etc. The Record Drawings shall indicate all critical elevations of piping, structures, finish grades, etc.
- H. Contractor shall have all weirs surveyed by a licensed land surveyor and adjusted to match specified elevations as shown on the Contract Drawings. Weirs shall be surveyed at no more than ten (10) feet spacing, but no less than 2 points shall be surveyed on each section of weir plate. Final elevations shall be set to within a tolerance of  $\pm 0.05$  inches of specified elevation. If a greater tolerance is allowed, it will be noted on the Contract Drawings. A final report showing all specified and surveyed elevations shall be certified by the surveyor and delivered to the Engineer.

#### 1.09 FIRE PROTECTION

- A. Contractor shall take all necessary precautions to prevent fires at or adjacent to the work, buildings, etc., and shall provide adequate facilities for extinguishing fires which do occur. Burning, if permitted in Division 2, shall be limited to areas approved by the Engineer and Owner and properly controlled by the Contractor.
- B. When fire or explosion hazards are created in the vicinity of the work as a result of the locations of fuel tanks, or similar hazardous utilities or devices, the Contractor shall immediately alert the local Fire Marshal, the Engineer, and the Owner of such tank or device.

The Contractor shall exercise all safety precautions and shall comply with all instructions issued by the Fire Marshal and shall cooperate with the Owner of the tank or device to prevent the occurrence of fire or explosion.

#### 1.10 CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, or reactant of other classification, must show approval of either the EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with all applicable rules and regulations.

#### 1.11 FIRST AID FACILITIES AND ACCIDENTS

##### A. First Aid Facilities

- 1. The Contractor shall provide at the site such equipment and facilities as are necessary to supply first aid to any of his personnel who may be injured in connection with the work.

##### B. Accidents

- 1. The Contractor shall promptly report, in writing, to the Engineer and Owner all accidents whatsoever out of, or in connection with, the performance of the work, whether on or adjacent to the site, which cause death, personal injury or property damage, giving full details and statements of witnesses.
- 2. If death, serious injuries, or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the Owner and the Engineer.
- 3. If any claim is made by anyone against the Contractor or a Subcontractor on account of any accidents, the Contractor shall promptly report the facts, in writing, to the Engineer and Owner, giving full details of the claim.

#### 1.12 ULTIMATE DISPOSITION OF CLAIMS BY ONE CONTRACTOR ARISING FROM ALLEGED DAMAGE BY ANOTHER CONTRACTOR

- A. During the progress of the work, other Contractors may be engaged in performing other work or may be awarded other Contracts for additional work on this project. In that event, the Contractor shall coordinate the work to be done hereunder with the work of such other Contractors and the Contractor shall fully cooperate with such other Contractors and carefully fit its own work to that provided under other Contracts as may be directed by the Engineer. The Contractor shall not commit or permit any act which will interfere with the performance of work by any other Contractor.
- B. If the Engineer shall determine that the Contractor is failing to coordinate his work with the work of the other Contractors as the Engineer directed, then the Owner shall have the right to withhold any payments otherwise due hereunder until the Contractor completely complies with the Engineer's directions.
- C. If the Contractor notifies the Engineer in writing that another Contractor is failing to coordinate his work with the work of this Contract as directed, the Engineer will promptly investigate the charge. If the Engineer finds it to be true, he will promptly issue such directions to the other Contractor with respect thereto as the situation may require. The

Owner, the Engineer, nor any of their agents shall not, however, be liable for any damages suffered by the Contractor by reason of the other Contractor's failure to promptly comply with the directions so issued by the Engineer, or by reason of another Contractor's default in performance, it being understood that the Owner does not guarantee the responsibility or continued efficiency of any Contractor.

- D. The Contractor shall indemnify and hold the Owner and the Engineer harmless from any and all claims of judgments for damages and from costs and expenses to which the Owner may be subjected or which it may suffer or incur by reason of the Contractor's failure to comply with the Engineer's directions promptly.
- E. Should the Contractor sustain any damage through any act or omission of any other Contractor having a Contract with the Owner for the performance of work upon the site or of work which may be necessary to be performed for the proper execution of the work to be performed hereunder, or through any act or omission of a Subcontractor of such Contract, the Contractor shall have no claim against the Owner or the Engineer for such damage, but shall have a right to recover such damage from the other Contractor under the provision similar to the following provisions which have been or will be inserted in the Contracts with such other Contractors.
- F. Should any other Contractor having or who shall hereafter have a Contract with the Owner for the performance of work upon the site sustain any damage through any act or omission of the Contractor hereunder or through any act or omission of any Subcontractor of the Contractor, the Contractor agrees to reimburse such other Contractor for all such damages and to defend at his own expense any suit based upon such claim and if any judgment or claims against the Owner shall be allowed, the Contractor shall pay or satisfy such judgment or claim and pay all costs and expenses in connection therewith and shall indemnify and hold the Owner harmless from all such claims.
- G. The Owner's right to indemnification hereunder shall in no way be diminished, waived or discharged, by its recourse to assessment of liquidated damages as provided in the Contract, or by the exercise of any other remedy provided for by Contract Documents or by law.

#### 1.13 LIMITS OF WORK AREA

- A. The Contractor shall confine his construction operations within the Contract limits shown on the Drawings and/or property lines and/or fence lines. Storage of equipment and materials, or erection and use of sheds outside of the Contract limits, if such areas are the property of the Owner, shall be used only with the Owner's approval. Such storage or temporary structures, even within the Contract's limits, shall be confined to the Owner's property and shall not be placed on properties designated as easements or rights of way unless specifically permitted elsewhere in the Contract Documents.

#### 1.14 WEATHER CONDITIONS

- A. No work shall be done when the weather is unsuitable. The Contractor shall take necessary precautions (in the event of impending storms) to protect all work, materials, or equipment from damage or deterioration due to floods, driving rain, or wind, and snow storms. The Owner reserves the right, through the opinion of the Engineer, to order that additional protection measures over and beyond those proposed by the Contractor, be taken to safeguard all components of the Project. The Contractor shall not claim any compensation

for such precautionary measures so ordered, nor claim any compensation from the Owner for damage to the work from weather elements.

- B. The mixing and placing of concrete or pavement courses, the laying of masonry, and installation of sewers and water mains shall be stopped during rainstorms, if ordered by the Engineer; and all freshly placed work shall be protected by canvas or other suitable covering in such manner as to prevent running water from coming in contact with it. Sufficient coverings shall be provided and kept ready at hand for this purpose. The limitations and requirements for mixing and placing concrete, or laying of masonry, in cold weather shall be as described elsewhere in these Specifications.

#### 1.15 PERIODIC CLEANUP: BASIC SITE RESTORATION

- A. During construction, the Contractor shall regularly remove from the site of the work all accumulated debris and surplus materials of any kind which result from his operations. Unused equipment and tools shall be stored at the Contractor's yard or base of operations for the Project.
- B. When the work involves installation of sewers, drains, water mains, manholes, underground structures, or other disturbance of existing features in or across streets, rights of way, easements, or private property, the Contractor shall (as the work progresses) promptly backfill, compact, grade, and otherwise restore the disturbed area to the basic condition which will permit resumption of pedestrian or vehicular traffic and any other critical activity or functions consistent with the original use of the land. The requirements for temporary paving of streets, walks, and driveways are specified elsewhere. Unsightly mounds of earth, large stones, boulders, and debris shall be removed so that the site presents a neat appearance.
- C. The Contractor shall perform the cleanup work on a regular basis and as frequently as ordered by the Engineer. Basic site restoration in a particular area shall be accomplished immediately following the installation or completion of the required facilities in that area. Furthermore, such work shall also be accomplished, when ordered by the Engineer, if partially completed facilities must remain incomplete for some time period due to unforeseen circumstances.
- D. Upon failure of the Contractor to perform periodic cleanup and basic restoration of the site to the Engineer's satisfaction, the Owner may, upon five (5) days prior written notice to the Contractor, without prejudice to any other rights or remedies of the Owner, cause such work for which the Contractor is responsible to be accomplished to the extent deemed necessary by the Engineer, and all costs resulting therefrom shall be charged to the Contractor and deducted from the amounts of money that may be due him.

#### 1.16 USE OF FACILITIES BEFORE COMPLETION

- A. The Owner reserves the right to enter and use any portion of the constructed facilities before final completion of the whole work to be done under this Contract. However, only those portions of the facilities which have been completed to the Engineer's satisfaction, as evidenced by his issuing a Certificate of Substantial Completion covering that part of the work, shall be placed in service.
- B. It shall be the Owner's responsibility to prevent premature connections to or use of any portion of the installed facilities by private or public parties, persons or groups of persons, before the Engineer issues his Certificate of Substantial Completion covering that portion of the work to be placed in service.

- C. Consistent with the approved progress schedule, the Contractor shall cooperate with the Owner, his agents, and the Engineer to accelerate completion of those facilities, or portions thereof, which have been designated for early use by the Owner.

#### 1.17 CONSTRUCTION VIDEO

- A. The Contractor shall video the entire project site including all concrete and asphalt pavements, curb and gutter, fencing to remain, structures to be demolished, and existing structures that are to be modified. The original video image shall be turned over to the Engineer prior to beginning construction activities. The video shall be provided as an Audio Video Interleave File (.avi) and shall be provided on DVD+R/DVD-ROM compatible media only. The video shall clearly identify existing site and structural conditions prior to construction.

#### PART 2 – PRODUCTS

(NOT USED)

#### PART 3 – EXECUTION

(NOT USED)

- - END OF SECTION - -



## SECTION 01040

### COORDINATION

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall allow the Owner or his agents, and other project Contractors or their agents, to enter upon the work for the purpose of constructing, operating, maintaining, removing, repairing, altering, or replacing such pipes, sewers, conduits, manholes, wires, poles, or other structures and appliances which may be required to be installed at or in the work. The Contractor shall cooperate with all aforesaid parties and shall allow reasonable provisions for the prosecution of any other work by the Owner, or others, to be done in connection with his work, or in connection with normal use of the facilities.
- B. Each Contractor shall cooperate fully with the Owner, the Engineer, and all other Contractors employed on the work, to effect proper coordination and progress to complete the project on schedule and in proper sequence. Insofar as possible, decisions of all kinds required from the Engineer shall be anticipated by the Contractor to provide ample time for inspection, or the preparation of instructions.
- C. Each Contractor shall assume full responsibility for the correlation of all parts of his work with that of other Contractors. Each Contractor's superintendent shall correlate all work with other Contractors in the laying out of work. Each Contractor shall lay out his own work in accordance with the Drawings, Specifications, and instructions of latest issue and with due regard to the work of other Contractors.
- D. Periodic coordinating conferences shall be held per Section 01200, Project Meetings, of these Contract Documents.

#### PART 2 – PRODUCTS

(NOT USED)

#### PART 3 – EXECUTION

(NOT USED)

- - END OF SECTION - -



## SECTION 01070

### ABBREVIATIONS

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The following is a partial list of typical abbreviations which may be used in the Specifications, and the organizations to which they refer:

AASHTO	-	American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
ACIFS	-	American Cast Iron Flange Standards
AFBMA	-	Anti-Friction Bearing Manufacturer's Association
AGA	-	American Gas Association
AGMA	-	American Gear Manufacturers Association
AIA	-	American Institute of Architects
AISC	-	American Institute of Steel Construction
AISI	-	American Iron and Steel Institute
ANSI	-	American National Standard Institute
API	-	American Petroleum Institute
ASCE	-	American Society of Civil Engineers
ASHRAE	-	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWS	-	American Welding Society
AWWA	-	American Water Works Association
CEMA	-	Conveyor Equipment Manufacturer's Association
CRSI	-	Concrete Reinforcing Steel Institute
DIPRA	-	Ductile Iron Pipe Research Association
Fed Spec	-	Federal Specifications
IEEE	-	Institute of Electrical and Electronic Engineers
IPCEA	-	Insulated Power Cable Engineers Association
ISO	-	Insurance Services Offices
NBS	-	National Bureau of Standards
NCDOT	-	North Carolina Department of Transportation
NEC	-	National Electric Code
NEMA	-	National Electrical Manufacturers Association
OSHA	-	Occupational Safety and Health Act
PCI	-	Precast Concrete Institute
UL	-	Underwriters Laboratories, Inc.
USGS	-	United States Geological Survey

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

## SECTION 01090

### REFERENCE STANDARDS

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. Wherever reference is made to any published standards, codes, or standard specifications, it shall mean the latest standard code, specification, or tentative specification of the technical society, organization, or body referred to, which is in effect at the date of invitation for Bids.
- B. All materials, products, and procedures used or incorporated in the work shall be in strict conformance with applicable codes, regulations, specifications, and standards.
- C. A partial listing of codes, regulations, specifications, and standards includes the following:

Air Conditioning and Refrigeration Institute (ARI)

Air Diffusion Council (ADC)

Air Moving and Conditioning Association (AMCA)

The Aluminum Association (AA)

American Architectural Manufacturers Association (AAMA)

American Concrete Institute (ACI)

American Gear Manufacturers Association (AGMA)

American Hot Dip Galvanizers Association (AHDGA)

American Institute of Steel Construction, Inc. (AISC)

American Iron and Steel Institute (AISI)

American National Standards Institute (ANSI)

American Society of Civil Engineers (ASCE)

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)

American Society of Mechanical Engineers (ASME)

American Society for Testing and Materials (ASTM)

American Standards Association (ASA)

American Water Works Association (AWWA)  
American Welding Society (AWS)  
American Wood-Preserver's Association (AWPA)  
Anti-Friction Bearing Manufacturers Association (AFBMA)  
Building Officials and Code Administrators (BOCA)  
Conveyor Equipment Manufacturers Association (CEMA)  
Consumer Product Safety Commission (CPSC)  
Factory Mutual (FM)  
Federal Specifications  
Instrument Society of America (ISA)  
Institute of Electrical and Electronics Engineers (IEEE)  
National and Local Fire Codes  
Lightning Protection Institute (LPI)  
National Electrical Code (NEC)  
National Electrical Manufacturer's Association (NEMA)  
National Electrical Safety Code (NESC)  
National Electrical Testing Association (NETA)  
National Fire Protection Association (NFPA)  
Regulations and Standards of the Occupational Safety and Health Act (OSHA)  
Southern Building Code Congress International, Inc. (SBCCI)  
Sheet Metal & Air Conditioning Contractors National Association (SMACNA)  
Standard Building Code  
Standard Mechanical Code  
Standard Plumbing Code  
Uniform Building Code (UBC)  
Underwriters Laboratories Inc. (UL)

- D. Contractor shall, when required, furnish evidence satisfactory to the Engineer that materials and methods are in accordance with such standards where so specified.
- E. In the event any questions arise as to the application of these standards or codes, copies shall be supplied on-site by the Contractor.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -





SECTION 01200  
PROJECT MEETINGS

PART 1 -- GENERAL

1.01 PRECONSTRUCTION MEETING

- A. A preconstruction meeting will be held after Award of Contract, but prior to starting work at the site.
- B. Attendance:
  - 1. Owner
  - 2. Engineer
  - 3. Contractor
  - 4. Major subcontractors
  - 5. Safety representative
  - 6. Representatives of governmental or other regulatory agencies.
- C. Minimum Agenda:
  - 1. Tentative construction schedule
  - 2. Critical work sequencing
  - 3. Designation of responsible personnel
  - 4. Processing of Field Decisions and Change Orders
  - 5. Adequacy of distribution of Contract Documents
  - 6. Submittal of Shop Drawings and samples
  - 7. Procedures for maintaining record documents
  - 8. Use of site and Owner's requirements
  - 9. Major equipment deliveries and priorities
  - 10. Safety and first aid procedures
  - 11. Security procedures
  - 12. Housekeeping procedures
  - 13. Processing of Partial Payment Requests
  - 14. General regard for community relations

1.02 PROGRESS MEETING

- A. Progress meetings will be held monthly at the Contractor's Field Office or the Office of the Owner during the performance of the work of this Contract. Additional meetings may be called as progress of work dictates.
- B. Engineer will preside at meetings and record minutes of proceedings and decisions. Engineer will distribute copies of minutes to participants.
- C. Attendance:
  - 1. Engineer
  - 2. Contractor

3. Subcontractors, only with Engineer's approval or request, as pertinent to the agenda

D. Minimum Agenda:

1. Review and approve minutes of previous meetings.
2. Review progress of Work since last meeting.
3. Review proposed 30-60 day construction schedule.
4. Note and identify problems which impede planned progress.
5. Develop corrective measures and procedures to regain planned schedule.
6. Revise construction schedule as indicated and plan progress during next work period.
7. Maintaining of quality and work standards.
8. Complete other current business.
9. Schedule next progress meeting.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

## SECTION 01300

### SUBMITTALS

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

###### A. Progress Schedule

1. Within thirty (30) days after issuance of the Notice to Proceed, the Contractor shall prepare and submit five (5) copies of his proposed progress schedule to the Engineer for review and approval.
2. If so required, the schedule shall be revised until it is approved by the Engineer.
3. Schedule shall be updated monthly, depicting progress to the last day of the month and five (5) copies submitted to the Engineer not later than the fifth day of the month, and prior to the application for progress payment. Failure to provide monthly schedule updates will be grounds for the Engineer or Owner to withhold progress payment approval.
4. Schedule shall be prepared in the form of a horizontal bar chart showing in detail the proposed sequence of the work and identifying construction activities for each structure and for each portion of work.
5. Schedule shall be time scaled, identifying the first day of each week. The Schedule shall be provided with estimated dates for Early Start, Early Finish, Late Start and Late Finish. The work shall be scheduled to complete the Project within the Contract time. The Late Finish date shall equal the Contract Completion Date.
6. Schedule shall show duration (number of days) and float for each activity. Float shall be defined as the measure of leeway in starting or completing a scheduled activity without adversely affecting the project completion date established by the Contract Documents.
7. Updated schedule shall show all changes since the previous submittal.
8. All revisions to the schedule must have the prior approval of the Engineer.

###### B. Equipment and Material Orders Schedule

1. Contractor shall prepare and submit five (5) copies of his schedule of principal items of equipment and materials to be purchased to the Engineer for review and approval.
2. If so required, the schedule shall be revised until it is approved by the Engineer.
3. Schedule shall be updated monthly and five (5) copies submitted to the Engineer not later than the fifth day of every month with the application for progress payment.
4. The updated schedule shall be based on the Progress Schedule developed under the requirements of Paragraph 1.01(A) of this Section.

5. Schedule shall be in tabular form with appropriate spaces to insert the following information for principal items of equipment and materials:
  - a. Dates on which Shop Drawings are requested and received from the manufacturer.
  - b. Dates on which certification is received from the manufacturer and transmitted to the Engineer.
  - c. Dates on which Shop Drawings are submitted to the Engineer and returned by the Engineer for revision.
  - d. Dates on which Shop Drawings are revised by manufacturer and resubmitted to the Engineer.
  - e. Date on which Shop Drawings are returned by Engineer annotated either "Furnish as Submitted" or "Furnish as Corrected".
  - f. Date on which accepted Shop Drawings are transmitted to manufacturer.
  - g. Date of manufacturer's scheduled delivery.
  - h. Date on which delivery is actually made.

C. Working Drawings

1. Within thirty (30) days after the Notice to Proceed, each prime Contractor shall prepare and submit five (5) copies of his preliminary schedule of Working Drawing submittals to the Engineer for review and approval. If so required, the schedule shall be revised until it is approved by the Engineer.
2. Working Drawings include, but are not limited to, Shop Drawings, layout drawings in plan and elevation, installation drawings, elementary wiring diagrams, interconnecting wiring diagrams, manufacturer's data, etc. Contractor shall be responsible for securing all of the information, details, dimensions, Drawings, etc., necessary to prepare the Working Drawings required and necessary under this Contract and to fulfill all other requirements of his Contract. Contractor shall secure such information, details, Drawings, etc., from all possible sources including the Drawings, Working Drawings prepared by subcontractors, Engineers, suppliers, etc.
3. Working Drawings shall accurately and clearly present the following:
  - a. All working and installation dimensions.
  - b. Arrangement and sectional views.
  - c. Units of equipment in the proposed positions for installation, details of required attachments and connections, and dimensioned locations between units and in relation to the structures.
  - d. Necessary details and information for making connections between the various trades including, but not limited to, power supplies and interconnecting wiring between units, accessories, appurtenances, etc.

4. In the event that the Engineer is required to provide additional engineering services as a result of a substitution of materials or equipment by the Contractor, the additional services will be provided in accordance with Section 01010 - Summary of Work, and will be covered in supplementary or revised Drawings which will be issued to the Contractor. All changes indicated that are necessary to accommodate the equipment and appurtenances shall be incorporated into the Working Drawings submitted to the Engineer.
5. Working Drawings specifically prepared for this Project shall be on mylar or other approved reproducible material sheets of the same size as the Drawings. Working Drawings shall conform to recognized drafting standards and be neat, legible and drawn to a large enough scale to show in detail the required information.
6. The Drawings are used for engineering and general arrangement purposes only and are not to be used for Working Drawings.
7. Shop Drawings
  - a. Contractor shall submit for review by the Engineer Shop Drawings for all fabricated work and for all manufactured items required to be furnished by the Contract Documents.
  - b. Structural and all other layout Drawings prepared specifically for the Project shall have a plan scale of not less than 1/4 inch = 1 foot.
  - c. Where manufacturer's publications in the form of catalogs, brochures, illustrations or other data sheets are submitted in lieu of prepared Shop Drawings, such submittals shall specifically indicate the item for which approval is requested. Identification of items shall be made in ink, and submittals showing only general information are not acceptable.
8. Layout and Installation Drawings
  - a. Contractor shall prepare and submit for review by the Engineer layout and installation drawings for all pipes, valves, fittings, sewers, drains, heating and ventilation ducts, all electrical, heating, ventilating and other conduits, plumbing lines, electrical cable trays, lighting fixture layouts, and circuiting, instrumentation, interconnection wiring diagrams, communications, power supply, alarm circuits, etc., under this Contract. The final dimensions, elevation, location, etc., of pipe, valves, fittings, sewers, ducts, conduits, electrical cable trays, equipment, etc., may depend upon the dimensions of equipment and valves to be furnished by the Contractor.
  - b. Layout and installation drawings are required for both interior and exterior piping, valves, fittings, sewers, drains, heating and ventilation ducts, conduits, plumbing lines, electrical cable trays, etc.
  - c. Layout and installation Drawings shall show connections to structures, equipment, sleeves, valves, fittings, etc.
  - d. Drawings shall show the location and type of all supports, hangers, foundations, etc., and the required clearances to operate valves, equipment, etc.

- e. The Drawings for pipes, ducts, conduits, etc., shall show all 3 inch and larger electrical conduits and pressure piping, electrical cable trays, heating and ventilation ducts or pipes, structure, manholes or any other feature within four (4) feet (measured as the clear dimension) from the pipe duct, conduit, etc., for which the profile is drawn.

9. Contractor Responsibilities

- a. All submittals from subcontractors, manufacturers or suppliers shall be sent directly to the Contractor for checking. Contractor shall thoroughly check all Drawings for accuracy and conformance to the intent of the Contract Documents. Drawings found to be inaccurate or otherwise in error shall be returned to the subcontractors, manufacturers, or suppliers by the Contractor for correction before submitting them to the Engineer.
- b. All submittals shall be bound, dated, properly labeled and consecutively numbered. Information on the label shall indicate Specification Section, Drawing number, subcontractor's, manufacturer's or supplier's name and the name or type of item the submittal covers. Each part of a submittal shall be marked and tabulated.
- c. Working Drawings shall be submitted as a single complete package including all associated drawings relating to a complete assembly of the various parts necessary for a complete unit or system.
- d. Shop Drawings shall be submitted as a single complete package for any operating system and shall include all items of equipment and any mechanical units involved or necessary for the functioning of such system. Where applicable, the submittal shall include elementary wiring diagrams showing circuit functioning and necessary interconnection wiring diagrams for construction.
- e. ALL SUBMITTALS SHALL BE THOROUGHLY CHECKED BY THE CONTRACTOR FOR ACCURACY AND CONFORMANCE TO THE INTENT OF THE CONTRACT DOCUMENTS BEFORE BEING SUBMITTED TO THE ENGINEER AND SHALL BEAR THE CONTRACTOR'S STAMP OF APPROVAL CERTIFYING THAT THEY HAVE BEEN SO CHECKED. SUBMITTALS WITHOUT THE CONTRACTOR'S STAMP OF APPROVAL WILL NOT BE REVIEWED BY THE ENGINEER AND WILL BE RETURNED TO THE CONTRACTOR.
- f. If the submittals contain any departures from the Contract Documents, specific mention thereof shall be made in the Contractor's letter of transmittal. Otherwise, the review of such submittals shall not constitute approval of the departure.
- g. No materials or equipment shall be ordered, fabricated, shipped or any work performed until the Engineer returns to the Contractor the submittals, herein required, annotated "Furnish as Submitted", "Furnish as Corrected", or "Furnish as Corrected – Confirm." If a submittal is returned "Furnish as Corrected – Confirm" the portions of work covered by the submittal that require confirmation by the Engineer shall not be ordered, fabricated, shipped, or any work performed until those portions are approved in a subsequent submittal either "Furnish as Submitted" or "Furnish as Corrected".
- h. Where errors, deviations, and/or omissions are discovered at a later date in any of the submittals, the Engineer's prior review of the submittals does not relieve the

Contractor of the responsibility for correcting all errors, deviations, and/or omissions.

10. Procedure for Review

- a. Submittals shall be transmitted in sufficient time to allow the Engineer at least thirty (30) working days for review and processing.
- b. Contractor shall transmit seven (7) copies of all technical data or drawing to be reviewed.
- c. Submittal shall be accompanied by a letter of transmittal containing date, project title, Contractor's name, number and titles of submittals, a list of relevant specification sections, notification of departures from any Contract requirement, and any other pertinent data to facilitate review.
- d. Submittals will be annotated by the Engineer in one of the following ways:
  1. "Furnish as Submitted" (FAS) no exceptions are taken
  2. "Furnish as Corrected" (FAC) minor corrections are noted and shall be made.
  3. "Furnish as Corrected – Confirm" (FACC) - some corrections are noted and a partial resubmittal or additional information are required as specifically requested.
  4. "Revise and Resubmit" (R&R) major corrections are noted and a full resubmittal is required.
  5. "For Information Only – Not Reviewed" (FIO) – submittal was received and was distributed for record purposes without review.
- e. If a submittal is satisfactory to the Engineer in full or in part, the Engineer will annotate the submittal "Furnish as Submitted", "Furnish as Corrected", or "Furnish as Corrected – Confirm", retain four (4) copies and return remaining copies to the Contractor. If reproducible transparencies are submitted, the Engineer will retain the copies and return the reproducible transparencies to the Contractor. In the case of "Furnish as Corrected – Confirm" a partial resubmittal or additional information are required as specifically requested.
- f. If a full resubmittal is required, the Engineer will annotate the submittal "Revise and Resubmit" and transmit three (3) copies to the Contractor for appropriate action. If reproducible transparencies are submitted, the Engineer will retain the copies and return the reproducible transparencies to the Contractor.
- g. Contractor shall continue to resubmit submittals in part if they are returned "Furnish as Corrected – Confirm" or in full if they are returned "Revise and Resubmit" as required by the Engineer until submittals are acceptable to the Engineer. It is understood by the Contractor that Owner may charge the Contractor the Engineer's charges for review in the event a submittal is not approved (either "Furnish as Submitted" or "Furnish as Corrected") by the third submittal for a system or piece of equipment. These charges shall be for all costs associated with engineering review, meetings with the Contractor or manufacturer, etc., commencing with the fourth submittal of a system or type of equipment submitted for a particular Specification Section.

- h. Acceptance of a Working Drawing by the Engineer will constitute acceptance of the subject matter for which the Drawing was submitted and not for any other structure, material, equipment or appurtenances indicated or shown.

#### 11. Engineer's Review

- a. Engineer's review of the Contractor's submittals shall in no way relieve the Contractor of any of his responsibilities under the Contract. An acceptance of a submittal shall be interpreted to mean that the Engineer has no specific objections to the submitted material, subject to conformance with the Contract Drawings and Specifications.
- b. Engineer's review will be confined to general arrangement and compliance with the Contract Drawings and Specifications only, and will not be for the purpose of checking dimensions, weights, clearances, fittings, tolerances, interferences, coordination of trades, etc.

#### 12. Record Working Drawings

- a. Contractor shall maintain current record drawings onsite for the Engineer's review. Record drawings shall be updated monthly at a minimum.
- b. Prior to final payment, the Contractor shall furnish the Engineer one complete set of all accepted Working Drawings, including Shop Drawings, for equipment, piping, electrical work, heating system, ventilating system, air conditioning system, instrumentation system, plumbing system, structural, interconnection wiring diagrams, etc.
- c. Working Drawings furnished shall be corrected to include any departures from previously accepted Drawings.

#### D. Operation and Maintenance Manuals

- 1. Two (2) preliminary copies of Operation and Maintenance Manuals, prepared specifically for this Project, shall be furnished for each item of equipment furnished under this Contract. The preliminary manuals shall be provided to the Engineer not less than 60 days prior to the start-up of the respective equipment.
- 2. The preliminary manuals shall be reviewed by the Engineer prior to the Contractor submitting final copies for distribution to the Owner. Following review of the preliminary copies of the Operation and Maintenance Manuals, one (1) copy will be returned to the Contractor with required revisions noted, or the acceptance of the Engineer noted.
- 3. Manuals shall contain complete information in connection with assembly, operation, lubrication, adjustment, wiring diagrams and schematics, maintenance, and repair, including detailed parts lists with drawings or photographs identifying the parts.
- 4. Manuals furnished shall be assembled and bound in separate volumes, by major equipment items or trades, and properly indexed to facilitate locating any required information. In addition, manuals should be labeled in the front cover with the project, name, equipment description, and manufacturer contact information.



5. Engineer and the Owner shall be the sole judge of the acceptability and completeness of the manuals and may reject any submittal for insufficient information included, incorrect references and/or the manner in which the material is assembled.
6. Following the Engineer's review of the preliminary manuals, the Contractor shall submit five (5) paper copies and two (2) electronic copies of the final Operation and Maintenance Manuals to the Engineer. The manuals shall reflect the required revisions noted during the Engineer's review of the preliminary documents. Failure of the final manuals to reflect the required revisions noted by the Engineer during a review of the Preliminary documents will result in the manuals being returned to the Contractor. Acceptable final Operation and Maintenance Manuals shall be provided not less than two week prior to equipment start-up.

E. Certified Shop Test Reports

1. Each piece of equipment for which pressure, head, capacity, rating, efficiency, performance, function or special requirements are specified or implied shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and applicable test codes and standards. Contractor shall keep the Engineer advised of the scheduling of shop tests so that the Engineer may arrange for the witnessing or inspection at the proper time and place.
2. The Contractor shall secure from the manufacturers seven (7) copies of the actual test data, the interpreted results and a complete description of the testing facilities and testing setup, all accompanied by a certificate of authenticity sworn to by a responsible official of the manufacturing company and notarized. These reports shall be forwarded to the Engineer for review.
3. In the event any equipment fails to meet the test requirements, the manufacturer shall make all necessary changes, adjustments or replacements and the tests shall be repeated, at no additional cost to the Owner or Engineer, until the equipment test requirements are acceptable to the Engineer.
4. No equipment shall be shipped to the Project until the Engineer notifies the Contractor, in writing, that the shop test reports are acceptable.

F. Samples

1. Contractor shall furnish for review all samples as required by the Contract Documents or requested by the Engineer.
2. Samples shall be of sufficient size or quantity to clearly illustrate the quality, type, range of color, finish or texture and shall be properly labeled to show the nature of the material, trade name of manufacturer and location of the work where the material represented by the sample will be used.
3. Samples shall be checked by the Contractor for conformance to the Contract Documents before being submitted to the Engineer and shall bear the Contractor's stamp of approval certifying that they have been so checked. Transportation charges on samples submitted to the Engineer shall be prepaid by the Contractor.
4. Engineer's review will be for compliance with the Contract Documents and his comments will be transmitted to the Contractor with reasonable promptness.

5. Accepted samples will establish the standards by which the completed work will be judged.

G. Construction Photographs

1. The General Contractor shall engage a competent photographer to take photographs at the locations and at such stages of the construction as directed by the Engineer. Kodak color film and color print paper or equal to be used for all negatives, proofs and enlargements.
2. Provide the equivalent of 36 different exposures per month for the duration of the Contract time. When directed by the Engineer, frequency of photographs may be increased to weekly sessions provided that the equivalent number of exposures is not exceeded. Engineer may waive requirements for photographs during inactive construction periods in favor of increased photographs during active construction sequences.
3. Submittal Requirements
  - a. One set of prints of each photograph required by Section 1.01(G), at least 3 inches by 5 inches in size, with the date, photographer's identification and description affixed thereto, shall be submitted to the Engineer within thirty (30) days of the date taken.
  - b. The Engineer shall select one photograph for enlargement from each series of photographs submitted under this Section. The Contractor shall furnish two glossy enlargements of each photograph as follows:
  - c. For prints required by Section 1.01G-2; two enlargements at least 8 inches by 10 inches in size. The equivalent of two (2) enlargements are required for each monthly series of photographs.
  - d. iFor aerial photographs required by Section 1.01G-3; two (2) 16 inch by 20 inch prints shall be provided. A total of six (6) such enlargements are required.
  - e. iiEnlargements shall be furnished within thirty (30) days of notification by the Engineer as to the prints selected for enlargement.
  - f. All enlargements shall have date, photographer's identification and description of subject permanently affixed to the back of the print.
  - g. At completion of the work, all electronic files and negatives shall be turned over to the Owner. Negatives shall be bound in specifically designed holders and identified as to date of exposure and subject matter.

PART 2 – PRODUCTS  
(NOT USED)

PART 3 – EXECUTION  
(NOT USED)

- - END OF SECTION - -

SECTION 01400  
QUALITY CONTROL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Testing Laboratory Services

1. Laboratory testing and checking required by the Specifications, including the cost of transporting all samples and test specimens, shall be provided and paid for by the Contractor unless otherwise indicated in the Specifications.
2. Materials to be tested include, but are not necessarily limited to the following: cement, concrete aggregate, concrete, bituminous paving materials, structural and reinforcing steel, waterproofing, select backfill, crushed stone or gravel and sand.
3. Tests required by the Owner shall not relieve the Contractor from the responsibility of supplying test results and certificates from manufacturers or suppliers to demonstrate conformance with the Specifications.
4. Procedure
  - a. The Contractor shall plan and conduct his operations to permit taking of field samples and test specimens, as required, and to allow adequate time for laboratory tests.
  - b. The collection, field preparation and storage of field samples and test specimens shall be as directed by the Engineer with the cooperation of the Contractor.
5. Significance of Tests
  - a. Test results shall be binding on both the Contractor and the Owner, and shall be considered irrefutable evidence of compliance or noncompliance with the Specification requirements, unless supplementary testing shall prove, to the satisfaction of the Owner, that the initial samples were not representative of actual conditions.
6. Supplementary and Other Testing
  - a. Nothing shall restrict the Contractor from conducting tests he may require. Should the Contractor at any time request the Owner to consider such test results, the test reports shall be certified by an independent testing laboratory acceptable to the Owner. Testing of this nature shall be conducted at the Contractor's expense.

## 1.02 FIELD TESTING OF EQUIPMENT

- A. All equipment shall be set, aligned and assembled in conformance with the manufacturer's drawings and instructions.
- B. Preliminary Field Tests, Yellow Tag
  1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall check the equipment for alignment, direction of rotation and that it is free from defects.
  2. Contractor shall flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.
  3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or his assigned representative and attached to the equipment. The tag shall not be removed.
  4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.
- C. Final Field Tests, Blue Tag
  1. Upon completion of the installation, and at a time approved by the Engineer, equipment will be tested by operating it as a unit with all related piping, ducting, electrical controls and mechanical operations.
  2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his assigned representative and the Owner or his assigned representative.
  3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration and noise. Equipment shall be tested for the characteristics as specified for the item.
  4. Each pump shall be tested at maximum rated speed for at least four points on the pump curve for capacity, head and electric power input. The rated motor nameplate current and power shall not be exceeded at any point within the specified range. Vibrometer readings shall be taken when directed by the Engineer and the results recorded. Additional tests shall be performed as prescribed in other sections of the Specifications.
  5. Pumps with drive motors rated at less than five horsepower shall only be tested for excess current or power when overheating or other malfunction becomes evident in general testing.
  6. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments and replacements at no additional cost to the Owner.
  7. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.

8. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed and no further construction work will be performed on the unit, except as required during start up operations and directed by the Engineer.
9. All costs in connection with such tests including all materials, equipment, instruments, labor, etc., shall be borne by the Contractor.

#### 1.03 IMPERFECT WORK, EQUIPMENT, OR MATERIALS

- A. Any defective or imperfect work, equipment, or materials furnished by the Contractor which is discovered before the final acceptance of the work, as established by the Certificate of Substantial Completion, or during the subsequent guarantee period, shall be removed immediately even though it may have been overlooked by the Engineer and estimated for payment. Any equipment or materials condemned or rejected by the Engineer shall be tagged as such and shall be immediately removed from the site. Satisfactory work or materials shall be substituted for that rejected.
- B. The Engineer may order tests of imperfect or damaged work, equipment, or materials to determine the required functional capability for possible acceptance, if there is no other reason for rejection. The cost of such tests shall be borne by the Contractor; and the nature, tester, extent and supervision of the tests will be as determined by the Engineer. If the results of the tests indicate that the required functional capability of the work, equipment, or material was not impaired, consistent with the final general appearance of same, the work, equipment, or materials may be deemed acceptable. If the results of such tests reveal that the required functional capability of the questionable work, equipment, or materials has been impaired, then such work, equipment, or materials shall be deemed imperfect and shall be replaced. The Contractor may elect to replace the imperfect work, equipment, or material in lieu of performing the tests.

#### 1.04 INSPECTION AND TESTS

- A. The Contractor shall allow the Engineer ample time and opportunity for testing materials and equipment to be used in the work. He shall advise the Engineer promptly upon placing orders for material and equipment so that arrangements may be made, if desired, for inspection before shipment from the place of manufacture. The Contractor shall at all times furnish the Engineer and his representatives, facilities including labor, and allow proper time for inspecting and testing materials, equipment, and workmanship. The Contractor must anticipate possible delays that may be caused in the execution of his work due to the necessity of materials and equipment being inspected and accepted for use. The Contractor shall furnish, at his own expense, all samples of materials required by the Engineer for testing, and shall make his own arrangements for providing water, electric power, or fuel for the various inspections and tests of structures and equipment.
- B. The Contractor shall furnish the services of representatives of the manufacturers of certain equipment, as prescribed in other Sections of the Specifications. The Contractor shall also place his orders for such equipment on the basis that, after the equipment has been tested prior to final acceptance of the work, the manufacturer will furnish the Owner with certified statements that the equipment has been installed properly and is ready to be placed in functional operation. Tests and analyses required of equipment shall be paid for by the Contractor, unless specified otherwise in the Section which covers a particular piece of equipment.

- C. Where other tests or analyses are specifically required in other Sections of these Specifications, the cost thereof shall be borne by the party (Owner or Contractor) so designated in such Sections. The Owner will bear the cost of all tests, inspections, or investigations undertaken by the order of the Engineer for the purpose of determining conformance with the Contract Documents if such tests, inspection, or investigations are not specifically required by the Contract Documents, and if conformance is ascertained thereby. Whenever nonconformance is determined by the Engineer as a result of such tests, inspections, or investigations, the Contractor shall bear the full cost thereof or shall reimburse the Owner for said cost. In this connection, the cost of any additional tests and investigations, which are ordered by the Engineer to ascertain subsequent conformance with the Contract Documents, shall be borne by the Contractor.

PART 2 – PRODUCTS  
(NOT USED)

PART 3 – EXECUTION  
(NOT USED)

- - END OF SECTION - -

## SECTION 01510

### TEMPORARY UTILITIES

#### PART 1 – GENERAL

##### 1. THE REQUIREMENT

- B. The General Contractor shall provide temporary light and power, heating, water service and sanitary facilities for his operations, for the construction operations of the other Contractors of this Project at the site. The temporary services shall be provided for use throughout the construction period.
- C. The General Contractor shall coordinate and install all temporary services in accordance with the requirements of the utility companies having jurisdiction and as required by applicable codes and regulations.
- D. At the completion of the work, or when the temporary services are no longer required, the facilities shall be restored to their original conditions.
- E. All costs in connection with the temporary services including, but not limited to, installation, utility company service charges, maintenance, relocation and removal shall be borne by the Contractor at no additional cost to the Owner.
- F. Some temporary facilities that may be required may be indicated on the Drawings; however, the Drawings do not necessarily show any or all of the temporary facilities that the Contractor ultimately uses to complete the work.
- G. Temporary Light and Power
  - 1. The temporary general lighting and small power requirements shall be serviced by 120/240 V, 1 phase, 3 wire temporary systems furnished and installed by the General Contractor. This service shall be furnished complete with main disconnect, overcurrent protection, meter outlet, branch circuit breakers, and wiring as required; including branch circuit breakers and wiring as required for furnishing temporary power to the various Contractor's field office service connections, all in accordance with the requirements of the servicing power company and applicable standards and codes. The meter for the temporary 120/240 V service for construction purposes shall be registered in the name of the General Contractor and all energy charges for furnishing this temporary electric power shall be borne by the General Contractor. Any Contractor with a need for power other than the 120/240 V, 1 phase, 3 wire shall provide such power at his own expense.
  - 2. The General Contractor shall make all necessary arrangements, and pay for all permits, inspections, and power company charges for all temporary service installations. All temporary systems shall comply with and meet the approval of the local authorities having jurisdiction. All temporary electrical systems shall consist of wiring, switches, necessary insulated supports, poles, fixtures, sockets, receptacles, lamps, guards, cutouts, and fuses as required to complete such installations. The General Contractor shall furnish lamps and fuses for all temporary systems furnished by him and shall replace broken and burned out lamps, blown fuses, damaged wiring and as required to maintain these

systems in adequate and safe operating condition. All such temporary light and power system shall be installed without interfering with the work of the other Contractors.

3. When it is necessary during the progress of construction that a temporary electrical facility installed under this Division interferes with construction operations, the General Contractor shall relocate the temporary electrical facilities to maintain temporary power as required at no additional cost to the Owner. The General Contractor shall be responsible at all times for any damage or injury to equipment, materials, or personnel caused by improperly protected or installed temporary installations and equipment.
4. The various Contractors doing the work at the site shall be permitted to connect into the temporary general lighting system small hand tools, such as drills, hammers, and grinders, provided that:
  - a. Equipment and tools are suitable for 120 V, single phase, 60 Hz operation and operating input does not exceed 1,500 volt amperes.
  - b. Tools are connected to outlets of the system with only one (1) unit connected to a single outlet.
  - c. In case of overloading of circuits, the General Contractor will restrict use of equipment and tools as required for correct loading.
5. The General Contractor shall keep the temporary general lighting and power systems energized fifteen minutes before the time that the earliest trade starts in the morning and de energized fifteen minutes after the time the latest trade stops. This applies to all weekdays, Monday through Friday, inclusive, which are established as regular working days.
6. Any Contractor requiring temporary light and power before or after the hours set forth hereinbefore, or on a Saturday, Sunday, or holiday, shall pay for the additional cost of keeping the system energized and repaired. If more than one Contractor is involved, the charges shall be prorated, such amounts to be determined from the meter readings or other acceptable means previously agreed upon by the Contractors involved. If it is necessary for any Contractor or his employees to be in any structure after regular working hours and the temporary general lighting system is not required for illumination, that Contractor shall provide such illumination required by means of flashlights, electric lanterns, or other devices not requiring use of electricity from the temporary general lighting system.
7. Each Contractor requiring additional power and lighting other than that specified herein (including power for temporary heating equipment to be provided by the General Contractor) shall furnish his own service complete with all fuses, cutouts, wiring and other material and equipment necessary for a complete system between the service point and the additional power consumers and shall install his own metering equipment in accordance with the requirements of the servicing power company.
8. The temporary general lighting system shall be installed progressively in structures as the various areas are enclosed or as lighting becomes necessary because of partial enclosure. Lighting intensities shall be not less than 10 foot candles.
9. The General Contractor shall provide a separate temporary night lighting circuit for construction security. This system shall be energized at the end of each normal working



day and de energized at the start of each normal working day by the General Contractor. The system is to be left energized over Saturdays, Sundays, and all holidays. Lighting intensities shall be not less than 2 foot candles.

10. Electrical welders provided by each trade used in the erection and fabrication of the buildings, structures and equipment shall be provided with an independent grounding cable connected directly to the structure on which the weld is being made rather than adjacent conduit piping, etc.
11. Electricians and other tradesmen necessary for the required connections and operation of welding equipment and generator, standby generators and similar equipment shall be furnished by the individual Contractors. All costs for such labor and equipment shall be borne by the individual Contractors.
12. Upon completion of the work, but prior to acceptance by the Owner, the General Contractor shall remove all temporary services, security lighting systems, temporary general lighting systems and all temporary electrical work from the premises.

#### H. Temporary Heating

1. The General Contractor shall provide temporary heating, ventilation coverings and enclosures necessary to properly protect all work and materials against damage by dampness and cold, to dry out the work and to facilitate work in all structures.
2. The equipment, fuel, materials, operating personnel and methods used shall be at all times satisfactory and adequate to maintain critical installation temperatures and ventilation for all work in those areas where the same is required.
3. After any structure is enclosed, the minimum temperature to be maintained is 50°F, unless otherwise specified, where work is actually being performed.
4. Before and during the application of interior finishing, painting, etc., the General Contractor shall provide sufficient heat to maintain a temperature of not less than 65°F.
5. Any work damaged by dampness or insufficient or abnormal heating shall be replaced by the General Contractor at no additional cost to the Owner.

#### I. Temporary Sanitary Service

1. Sanitary conveniences, in sufficient numbers, for the use of all persons employed on the work and properly screened from public observation, shall be provided and maintained at suitable locations by the General Contractor, all as prescribed by State Labor Regulations and local ordinances. The contents of same shall be removed and disposed of in a manner consistent with local and state regulations, as the occasion requires. Each Contractor shall rigorously prohibit the committing of nuisances within, on, or about the work. Sanitary facilities shall be removed from the site when no longer required.

#### J. Temporary Water

1. The General Contractor shall provide temporary water service for construction purposes, sanitary facilities, fire protection, field offices and for cleaning. The Contractor shall make all arrangements for connections to the potable water at the plant site. The Contractor shall pay all charges associated with the connection and all charges for potable water used under this Contract.

2. Each Contractor shall supply potable water for his employees either by portable containers or drinking fountains.
3. An adequate number of hose bibbs, hoses, and watertight barrels shall be provided for the distribution of water.
4. Water service shall be protected from freezing and the service shall be extended and relocated as necessary to meet temporary water requirements.

PART 2 – PRODUCTS  
(NOT USED)

PART 3 – EXECUTION  
(NOT USED)

- - END OF SECTION - -

## SECTION 01520

### MAINTENANCE OF UTILITY OPERATIONS DURING CONSTRUCTION

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. The existing pump station will be maintained in continuous operation by the Owner during the entire construction period of all Contracts as hereinafter specified. The intent of this section is to outline the minimum requirements necessary to allow the Owner to continuously operate and maintain the treatment facility in order to remain in compliance with all permit requirements.
- B. Work under each Contract shall be scheduled and conducted by each Contractor so as not to impede any pump station process, or cause odor or other nuisance except as explicitly permitted hereinafter. In performing the work shown and specified, the Contractor shall plan and schedule his work to meet the plant and collection system operating requirements, and the constraints and construction requirements as outlined in this Section. No discharge of raw or inadequately treated wastewater shall be allowed. The Contractor shall pay all civil penalties, costs, assessments, etc., associated with any discharge of raw or inadequately treated wastewater associated with the Contractor's work.
- C. The General Contractor shall be responsible for coordinating the general construction and electrical, HVAC and plumbing construction schedules and for ensuring that permanent or temporary power is available for all existing, proposed, and temporary facilities that are required to be on line at any given time.
- D. The Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without cost to the Owner and provided that all requirements of these Specifications are fulfilled. The Contractor shall submit any such plan for providing additional temporary facilities to eliminate a constraint to the PM for review. Such plans must be approved by the Engineer and Owner prior to the Contractor proceeding. Work not specifically covered in the following paragraphs may, in general, be done at any time during the contract period, subject to the operating requirements and constraints and construction requirements outlined hereinafter. All references to days in this Section shall be consecutive calendar days.

##### 1.02 GENERAL CONSTRAINTS

- A. The Contractor shall schedule the Work so that the pump station is maintained in continuous operation. All treatment processes shall be maintained in continuous operation during the construction period except during approved process interruptions. All short term system or partial systems shutdowns and diversions shall be approved by the Engineer. Long term process shutdowns and diversions shall conform to the requirements hereinafter specified and shall be minimized by the Contractor as much as possible. If in the judgement of the Engineer a requested shutdown is not required for the Contractor to perform the Work, the Contractor shall utilize approved alternative methods to accomplish the Work. All shutdowns shall be coordinated with and scheduled at times suitable to the Owner. Shutdowns shall not begin until all required materials are on hand and ready for installation. Each shutdown

period shall commence at a time approved by the Owner, and the Contractor shall proceed with the Work continuously, start to finish, until the Work is completed and normal pump station operation is restored. If the Contractor completes all required Work before the specified shutdown period has ended, the Owner may immediately place the existing system back into service.

- B. The Contractor shall schedule short term and long-term shutdowns in advance and shall present all desired shutdowns in the 30 and 60 day schedules at the progress meetings (see Section 01200). Shutdowns shall be fully coordinated with the Owner at least 48 hours before the scheduled shutdown. Owner personnel shall operate Owner's facilities involved in the short term and long-term shutdowns and diversions.
  - C. Short term shutdowns will be allowed for tie ins to existing facilities, installation of temporary bulkheads, etc. All such shutdowns shall be scheduled for week end low flow periods and shall be limited to less than two (2) hours depending on incoming flow rate and storage volume in the collection. Any shutdown of two (2) hours or longer duration shall be defined as a long-term shutdown. The Contractor shall provide appropriate diversion facilities to be approved by the Owner, and at no additional cost to the Owner, when the pump station cannot be shut down for a sufficient long time to accomplish the required work. The Contractor may be allowed additional time for short term interruptions if he can demonstrate to the Owner and Engineer that the collection system will not surcharge or overflow during the requested shutdown period. Duration of short term interruptions allowed will depend on incoming wastewater flow rate and prevention of any discharge of raw wastewater from the collection system. The schedule and duration of short term shutdowns shall be at the discretion of the Owner.
  - D. Any temporary work, facilities, roads, walks, protection of existing structures, piping, blind flanges, valves, equipment, etc. that may be required within the Contractor's work limits to maintain continuous and dependable pump station operation shall be furnished by the Contractor at the direction of the Engineer at no extra cost to the Owner.
  - E. The Owner shall have the authority to order Work stopped or prohibited that would, in his opinion, unreasonably result in interrupting the necessary functions of the pump station operations.
  - F. If the contractor impairs performance or operation of the existing pump station as a result of not complying with specified provisions for maintaining pump station operations, then the contractor shall immediately make all repairs or replacements and do all work necessary to restore the pump station to operation to the satisfaction of the Engineer. Such work shall progress continuously to completion on a 24 hours per day, seven work days per week basis.
  - G. The Contractor shall provide the services of emergency repair crews on call 24 hours per day to affect repairs to portions of the pump station affected by the Contractor's operations.
- 1.03 GENERAL OPERATING REQUIREMENTS, CONSTRAINTS, AND CONSTRUCTION REQUIREMENTS
- A. Access to Pump Station Site, Roadways, and Parking Areas
    - 1. An unobstructed traffic route through the Main Gate shall be maintained at all times for the Owner's operations personnel and maintenance equipment. Construction personnel may park on City property outside the pump station fence in areas approved by the

Engineer. The General Contractor shall be responsible for providing access to and for preparing and maintaining/approved parking areas.

2. An unobstructed traffic route around the pump station site shall be maintained at all times for the Owner's operations personnel and maintenance equipment. Vehicular access to the pump station for Owner personnel shall be maintained at all times by the Contractor.
3. The Contractor shall provide temporary measures to protect the existing pavement by filling over with earthen material or supplying other measures acceptable to the Engineer, and he shall repair any damage to existing paved surfaces that occurs during the construction period. Any areas disturbed along the shoulders of the access road and interior roads and elsewhere inside and outside of the pump station shall be repaired, graded, seeded, etc. as necessary to match pre existing conditions.
4. The General Contractor shall not undertake the restoration/construction of new roadway (paved, gravel, or asphalt overlay) shown on the Contract Drawings, until all other work has been completed.
5. It shall be the responsibility of the General Contractor to obtain any permits required from the N.C. Department of Transportation and pay all associated fees.

B. Personnel Access

1. Owner personnel shall have access to all areas which remain in operation throughout the construction period. The Contractor shall locate stored material, dispose of construction debris and trash, provide temporary walkways, provide temporary lighting, and other such work as directed by the Engineer to maintain personnel access to areas in operation. Access and adequate parking areas for pump station personnel must be maintained throughout construction.

C. Power, Light and Communications Systems (General)

1. Electric power, lighting service and communications systems shall be maintained in uninterrupted operation in all areas which remain in operation. Individual units may be disconnected as required for replacement, but service shall be available at all times including periods when the pump station is out of service. Shutdown of electrical facilities shall be limited to not more than five (5) hours. The Owner may allow longer outages under conditions determined by the Owner by making use of the existing and/or the proposed engine generator at the pump station. All costs associated with operation of the engine generators shall be paid by the Contractor. The Electrical Contractor shall coordinate shutdowns required with the General Contractor to minimize the total number of shutdowns required to complete construction.

D. Draining Process Pipes and Conduits (General)

1. The contents of all pipes and conduits to be removed, replaced or relocated (or dewatered for a specific purpose) shall be transferred to a suitable facility in a manner approved by the Owner through hoses or piping, or by using pumps if hydraulic conditions so require them. The Contractor shall provide the pumps, piping and hoses at no additional cost to the Owner. No uncontrolled spillage of a pipe or conduit shall be permitted. Any spillage, other than potable water, shall be immediately washed down and flushed into the appropriate process flow train.

E. Potable Water System

1. Potable water service shall be maintained in continuous service at all times during construction except for short term interruptions required for tie ins. Shutdown of the potable water system shall be fully planned and coordinated with the Owner and shall be limited to not more than two (2) hours. Existing fire hydrants within the pump station site shall be operational at all times, unless otherwise approved by the Owner.

1.04 SPECIFIC OPERATIONAL CONSTRAINTS

- A. The respective Contractors shall schedule the work for the following based on the constraints given in such a manner as to maintain the pump station in continuous operation.
  1. The new pump station must be in continuous operation for a minimum of seven (7) days prior to the demolition of the existing pump station.
  2. All pump station and generator testing for the new pump station must be completed prior to demolition of the existing pump station.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

- - END OF SECTION - -

## SECTION 01530

### PROTECTION OF EXISTING FACILITIES

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. Contractor shall be responsible for the preservation and protection of property adjacent to the work site against damage or injury as a result of his operations under this Contract. Any damage or injury occurring on account of any act, omission or neglect on the part of the Contractor shall be restored in a proper and satisfactory manner or replaced by and at the expense of the Contractor to an equal or superior condition than previously existed.
- B. Contractor shall comply promptly with such safety regulations as may be prescribed by the Owner or the local authorities having jurisdiction and shall, when so directed, properly correct any unsafe conditions created by, or unsafe practices on the part of, his employees. In the event of the Contractor's failure to comply, the Owner may take the necessary measures to correct the conditions or practices complained of, and all costs thereof will be deducted from any monies due the Contractor. Failure of the Engineer to direct the correction of unsafe conditions or practices shall not relieve the Contractor of his responsibility hereunder.
- C. In the event of any claims for damage or alleged damage to property as a result of work under this Contract, the Contractor shall be responsible for all costs in connection with the settlement of or defense against such claims. Prior to commencement of work in the vicinity of property adjacent to the work site, the Contractor, at his own expense, shall take such surveys as may be necessary to establish the existing condition of the property. Before final payment can be made, the Contractor shall furnish satisfactory evidence that all claims for damage have been legally settled or sufficient funds to cover such claims have been placed in escrow, or that an adequate bond to cover such claims has been obtained.

##### 1.02 PROTECTION OF WORK AND MATERIAL

- A. During the progress of the work and up to the date of final payment, the Contractor shall be solely responsible for the care and protection of all work and materials covered by the Contract, except as provided for in Article 14.05 of the Supplementary Conditions.
- B. All work and materials shall be protected against damage, injury or loss from any cause whatsoever, and the Contractor shall make good any such damage or loss at his own expense. Protection measures shall be subject to the approval of the Engineer.

##### 1.03 BARRICADES, WARNING SIGNS AND LIGHTS

- A. The General Contractor shall provide, erect and maintain as necessary, strong and suitable barricades, danger signs and warning lights along all roads accessible to the public, as required by the authority having jurisdiction, to insure safety to the public. All barricades and obstructions along public roads shall be illuminated at night and all lights for this purpose shall be kept burning from sunset to sunrise.

- B. Each Contractor shall provide and maintain such other warning signs and barricades in areas of and around their respective work as may be required for the safety of all those employed in the work, the Owner's operating personnel, or those visiting the site.

#### 1.04 EXISTING UTILITIES AND STRUCTURES

- A. The term existing utilities shall be deemed to refer to both publicly owned and privately owned utilities such as electric power and lighting, telephone, water, gas, storm drains, process lines, sanitary sewers and all appurtenant structures.
- B. Where existing utilities and structures are indicated on the Drawings, it shall be understood that all of the existing utilities and structures affecting the work may not be shown and that the locations of those shown are approximate only. It shall be the responsibility of the Contractor to ascertain the actual extent and exact location of existing utilities and structures. In every instance, the Contractor shall notify the proper authority having jurisdiction and obtain all necessary directions and approvals before performing any work in the vicinity of existing utilities.
- C. Prior to beginning any excavation work, the Contractor shall, through field investigations, determine any conflicts or interferences between existing utilities and new utilities to be constructed under this project. This determination shall be based on the actual locations, elevations, slopes, etc., of existing utilities as determined in the field investigations, and locations, elevation, slope, etc. of new utilities as shown on the Drawings. If an interference exists, the Contractor shall bring it to the attention of the Engineer as soon as possible. If the Engineer agrees that an interference exists, he shall modify the design as required. Additional costs to the Contractor for this change shall be processed through a Change Order as detailed elsewhere in these Contract Documents. In the event the Contractor fails to bring a potential conflict or interference to the attention of the Engineer prior to beginning excavation work, any actual conflict or interference which does arise during the Project shall be corrected by the Contractor, as directed by the Engineer, at no additional expense to the Owner.
- D. The work shall be carried out in a manner to prevent disruption of existing services and to avoid damage to the existing utilities. Temporary connections shall be provided, as required, to insure uninterrupted of existing services. Any damage resulting from the work of this Contract shall be promptly repaired by the Contractor at his own expense in a manner approved by the Engineer and further subject to the requirements of any authority having jurisdiction. Where it is required by the authority having jurisdiction that they perform their own repairs or have them done by others, the Contractor shall be responsible for all costs thereof.
- E. Where excavations by the Contractor require any utility lines or appurtenant structures to be temporarily supported and otherwise protected during the construction work, such support and protection shall be provided by the Contractor. All such work shall be performed in a manner satisfactory to the Engineer and the respective authority having jurisdiction over such work. In the event the Contractor fails to provide proper support or protection to any existing utility, the Engineer may, at his discretion, have the respective authority to provide such support or protection as may be necessary to insure the safety of such utility, and the costs of such measures shall be paid by the Contractor.

#### PART 2 – PRODUCTS

(NOT USED)



PART 3 – EXECUTION  
(NOT USED)

- - END OF SECTION - -



## SECTION 01550

### SITE ACCESS AND STORAGE

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

###### A. Access Roads

1. The General Contractor shall construct and maintain such temporary access roads as required to perform the work of this Contract.
2. Access roads, where possible, shall be located over the areas of the future road system.
3. Access roads shall be located within the property lines of the Owner unless the Contractor independently secures easements for his use and convenience. Contractor shall submit written documentation to the Engineer for any Contractor secured easements across privately held property. Easement agreement shall specify terms and conditions of use and provisions for site restoration. A written release from the property owner certifying that all terms of the easement agreement have been complied by the Contractor shall be furnished to the Engineer prior to final payment.
4. Existing access roads used by the Contractor shall be suitably maintained by the Contractor at his expense during construction. Contractor shall not be permitted to restrict Owner access to existing facilities. Engineer may direct Contractor to perform maintenance of existing access roads when Engineer determines that such work is required to insure all weather access by the Owner.
5. The Contractor shall obtain and pay all cost associated with any bonds required by the N.C. Department of Transportation for the use of State maintained roads.
6. The access road through the State Forest property can be cleared of existing fallen trees and debris, but no other clearing or tree removal is allowed.

###### B. Parking Areas

1. Each Contractor shall construct and maintain suitable parking areas for his construction personnel on the project site where approved by the Engineer and the Owner.

###### C. Restoration

1. At the completion of the work, the surfaces of land used for access roads and parking areas shall be restored by each Contractor to its original condition and to the satisfaction of the Engineer. At a minimum, such restoration shall include establishment of a permanent ground cover adequate to restrain erosion for all disturbed areas.

#### D. Traffic Regulations

1. Contractor shall obey all traffic laws and comply with all the requirements, rules and regulations of the (NCDOT, etc.) and other local authorities having jurisdiction to maintain adequate warning signs, lights, barriers, etc., for the protection of traffic on public roadways.

#### E. Storage of Equipment and Materials

1. Contractor shall store his equipment and materials at the job site in accordance with the requirements of the General Conditions, the Supplemental Conditions, and as hereinafter specified. All equipment and materials shall be stored in accordance with manufacturer's recommendations and as directed by the Owner or Engineer, and in conformity to applicable statutes, ordinances, regulations and rulings of the public authority having jurisdiction. Where space or strip heaters are provided within the enclosure for motors, valve operators, motor starters, panels, instruments, or other electrical equipment, the Contractor shall make connections to these heaters from an appropriate power source and operate the heaters with temperature control as necessary until the equipment is installed and being operated according to its intended use.
2. Contractor shall enforce the instructions of Owner and Engineer regarding the posting of regulatory signs for loadings on structures, fire safety, and smoking areas.
3. Contractor shall not store materials or encroach upon private property without the written consent of the owners of such private property.
4. Contractor shall not store unnecessary materials or equipment on the job site, and shall take care to prevent any structure from being loaded with a weight which will endanger its security or the safety of persons.
5. Materials shall not be placed within ten (10) feet of fire hydrants. Gutters, drainage channels and inlets shall be kept unobstructed at all times.
6. Contractor shall provide adequate temporary storage buildings/facilities, if required, to protect materials or equipment on the job site.

#### PART 2 – PRODUCTS

(NOT USED)

#### PART 3 – EXECUTION

(NOT USED)

- - END OF SECTION - -

SECTION 01560  
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Dust Control

1. Contractor shall take all necessary measures to control dust from his operations, and to prevent spillage of excavated materials on public roads.
2. Contractor shall remove all spillage of excavated materials, debris or dust from public roads by methods approved by the Engineer.
3. Contractor shall sprinkle water at locations and in such quantities and at such frequencies as may be required by the Engineer to control dust and prevent it from becoming a nuisance to the surrounding area.
4. Dust control and cleaning measures shall be provided at no additional cost to the Owner.

PART 2 – PRODUCTS  
(NOT USED)

PART 3 – EXECUTION  
(NOT USED)

- - - END OF SECTION - - -



SECTION 01600  
MATERIALS AND EQUIPMENT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish and Install

1. Where the words "furnish", "provide", "supply", "replace", or "install" are used, whether singularly or in combination, they shall mean to furnish and install, unless specifically stated otherwise.
2. In the interest of brevity, the explicit direction "to furnish and install" has sometimes been omitted in specifying materials and/or equipment herein. Unless specifically noted otherwise, it shall be understood that all equipment and/or materials specified or shown on the Drawings shall be furnished and installed under the Contract as designated on the Drawings.

B. Concrete Foundations for Equipment

1. Each Contractor shall provide all concrete foundations shown, specified or required for all equipment furnished under their respective Contract.
2. Anchor bolts and templates for equipment foundations shall be furnished under the respective Contracts for installation by the respective Contractor. The General Contractor shall cooperate with the respective Contractors to secure a satisfactory installation and to maintain the schedule of construction.
3. All concrete foundations for equipment shall be treated, by the respective Contractor, with an approved sealer to prevent oil from seeping into the concrete.

1.02 EQUIPMENT AND MATERIALS

- A. All equipment, materials, instruments or devices incorporated in this project shall be new and unused, unless indicated otherwise in the Contract Documents. Equipment and materials to be incorporated into the work shall be delivered sufficiently in advance of their installation and use to prevent delay in the execution of the work, and they shall be delivered as nearly as feasible in the order required for executing the work.
- B. The Contractor shall protect all equipment and materials from deterioration and damage, including provisions for temporary storage buildings as needed and as specified in Section 01550, Site Access and Storage. Storage of equipment and materials shall be in locations completely protected from flooding, standing water, excessive dust, falling rock, brush fire, etc. Storage areas shall be located sufficiently distant from all construction activities and the movement of construction vehicles to minimize the potential for accidental damage. Any equipment or materials of whatever kind which may have become damaged or deteriorated

from any cause shall be removed and replaced by good and satisfactory items at the Contractor's expense for both labor and materials.

### 1.03 INSTALLATION OF EQUIPMENT

- A. Equipment and materials shall be installed in accordance with the requirements of the General Conditions, Supplemental Conditions and the respective Specification Sections.
- B. Concrete foundations for equipment shall be of approved design and shall be adequate in size, suitable for the equipment erected thereon, properly reinforced, and tied into floor slabs by means of reinforcing bars or dowels. Foundation bolts of ample size and strength shall be provided and properly positioned by means of suitable templates and secured during placement of concrete. Foundations shall be built and bolts installed in accordance with the manufacturer's certified drawings.
- C. Before mounting equipment on a foundation, the Contractor shall clean the top surface; if necessary, rough it with a star chisel and clean again; and clean out all foundation bolt sleeves. The Contractor shall provide a sufficient number of steel plate shims about 2 inches wide and 4 inches long, and of a varying thickness from 1/8 to 1/2 inch. A combination of these shims shall be placed next to each foundation bolt to bring the bottom of the bedplate or frame about 1/8 inch above the final setting. The equipment shall be lowered by changing the combination of shims. Using brass shim stock of various thicknesses, continue to level the equipment a little at a time and in rotation until it is at the correct elevation in both directions. When the equipment is level, tighten down on the foundation bolts a little at a time in rotation to make certain the equipment remains level and does not shift on the shims. A preliminary alignment check shall be made before grout is placed.
- D. Equipment shall be set, aligned and assembled in conformance with manufacturer's drawings or instructions. Run out tolerances by dial indicator method of alignment shall be plus or minus .002 inches, unless otherwise approved by the Engineer.
- E. All blocking and wedging required for the proper support and leveling of equipment during installation shall be furnished by the Contractor. All temporary supports shall be removed, except steel wedges and shims, which may be left in place with the approval of the Engineer.
- F. Each piece of equipment or supporting base, bearing on concrete foundations, shall be bedded in grout. The Contractor shall provide a minimum of 1 1/2 inch thick grouting under the entire baseplate supporting each pump, motor drive unit and other equipment. Grout shall be non shrink grout, as specified under Section 03600, Grout.
- G. When motors are shipped separately from driven equipment, the motors shall be received, stored, meggered once a month, and the reports submitted to the Engineer. After driven equipment is set, the motors shall be set, mounted, shimmed, millrighted, coupled and connected complete.

### 1.04 CONNECTIONS TO EQUIPMENT

- A. Connections to equipment shall follow manufacturer's recommendations as to size and arrangement of connections and/or as shown in detail on the Drawings or approved Shop Drawings. Piping connections shall be made to permit ready disconnection of equipment with minimum disturbance of adjoining piping and equipment.



- B. The Electrical Contractor or General Contractor if no electrical contract exists shall be responsible for bringing proper electrical service to each item of equipment requiring electrical service as shown on the Drawings or approved Shop Drawings. Electrical connections to equipment requiring electrical service shall be made by the Electrical Contractor, unless otherwise indicated on the Drawings or in the Technical Specifications.
- C. The HVAC Contractor or General Contractor if no HVAC Contract exists shall bring and connect HVAC service to all equipment items requiring same as shown on the Drawings. Electrical connections to equipment requiring electrical service shall be made by the Electrical Contractor, unless otherwise indicated on the Drawings or in the Technical Specifications.
- D. The Plumbing Contractor or General Contractor if no plumbing contract exists shall bring and connect plumbing service to all equipment items requiring same as shown on the Drawings.

#### 1.05 SUBSTITUTIONS

- A. Requests for substitutions of equipment or materials shall conform to the requirements of the General Conditions, Supplemental Conditions, and as hereinafter specified.
  - 1. Contractor shall submit for each proposed substitution sufficient details, complete descriptive literature and performance data together with samples of the materials, where feasible, to enable the Owner and Engineer to determine if the proposed substitution is equal.
  - 2. Contractor shall submit certified tests, where applicable, by an independent laboratory attesting that the proposed substitution is equal.
  - 3. A list of installations where the proposed substitution is equal.
  - 4. Requests for substitutions shall include full information concerning differences in cost, and any savings in cost resulting from such substitutions shall be passed on to the Owner.
- B. Where the approval of a substitution requires revision or redesign of any part of the work, including that of other Contracts, all such revision and redesign, and all new drawings and details therefore, shall be provided by the Contractor at his own cost and expense, and shall be subject to the approval of the Owner and Engineer.
- C. In the event that the Engineer is required to provide additional engineering services, then the Engineer's charges for such additional services shall be charged to the Contractor by the Owner in accordance with the requirements of the General Conditions, and the Supplemental Conditions.
- D. In all cases the Owner and Engineer shall be the judge as to whether a proposed substitution is to be approved. The Contractor shall abide by their decision when proposed substitute items are judged to be unacceptable and shall in such instances furnish the item specified or indicated. No substitute items shall be used in the work without written approval of the Owner and Engineer.
- E. Contractor shall have and make no claim for an extension of time or for damages by reason of the time taken by the Engineer in considering a substitution proposed by the Contractor or by reason of the failure of the Engineer to approve a substitution proposed by the Contractor.

- F. Acceptance of any proposed substitution shall in no way release the Contractor from any of the provisions of the Contract Documents.

PART 2 – PRODUCTS  
(NOT USED)

PART 3 – EXECUTION  
(NOT USED)

- - END OF SECTION - -

SECTION 01700  
PROJECT CLOSEOUT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Final Cleaning

1. At the completion of the work, the Contractor shall remove all rubbish from and about the site of the work, and all temporary structures, construction signs, tools, scaffolding, materials, supplies and equipment which he or any of his Subcontractors may have used in the performance of the work. Contractor shall broom clean paved surfaces and rake clean other surfaces of grounds.
2. Contractor shall thoroughly clean all materials, equipment and structures; all marred surfaces shall be touched up to match adjacent surfaces; dirty filters and burned out lights replaced as required; all glass surfaces cleaned and floors cleaned and polished so as to leave work in a clean and new appearing condition.
3. Contractor shall maintain cleaning until project, or portion thereof, is occupied by the Owner.

B. Lubrication Survey

1. A lubrication survey, made by a lubricant supply firm, subject to the approval of the Owner shall be provided and paid for by the Contractor.
2. The lubrication survey shall list all equipment, the equipment manufacturer's lubrication recommendations, and an interchangeable lubricants tabulation standardizing and consolidating lubricants whenever possible.
3. The Contractor shall supply all lubricants, applicators and labor for lubricating the equipment, in accordance with manufacturer's recommendations, for field testing and prior to final acceptance. A supply of required lubricants sufficient for start up and one year of operation shall also be supplied by the Contractor.
4. Ten (10) copies of the approved lubrication survey shall be furnished to the Engineer prior to final acceptance.

C. Spare Parts and Special Tools

1. As soon as practicable after approval of the list of equipment, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and source or sources of supply.
2. Contractor shall also furnish a list of parts, and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified to be

furnished as part of the Contract and a list of additional items recommended by the manufacturer to assure efficient operation for a period of one-hundred and twenty (120) days for the particular installation.

3. All parts shall be securely boxed and tagged, and clearly marked on the box and individually for identification as to the name of manufacturer or supplier, applicable equipment, part number, description and location in the equipment. All parts shall be protected and packaged for a shelf life of at least ten (10) years.
4. Contractor shall furnish at no additional cost to the Owner with each piece of equipment as a minimum, one (1) complete set, or the number of sets called for in the Technical Specifications, of suitably marked special tools and appliances which may be needed to adjust, operate, maintain, or repair the equipment.
5. Contractor shall submit, for approval by the Engineer, a complete list of the special tools and appliances to be furnished. Such tools and appliances shall be furnished in approved painted steel cases properly labeled and equipped with good grade cylinder locks and duplicate keys.

D. Equipment Start Up Services

1. Equipment start up period, for the training of plant personnel, shall begin after satisfactory completion and acceptance of the field tests and coincidentally with the certified date of substantial completion for the part of the work for which the equipment is included. If the equipment is not covered by a certificate of substantial completion for a part of the work, the period shall begin upon substantial completion of the project.
2. During the equipment start up period the Contractor shall furnish, at no additional cost to the Owner the services of factory trained representatives of the equipment manufacturers for the equipment designated in the Specifications to:
  - a) Assist in the startup and operations of the equipment.
  - b) Assist in the training of plant personnel, designated by the Owner in the proper operation and maintenance of the equipment.
3. The Owner shall:
  - a) Provide the necessary plant personnel to be instructed in the operation and maintenance of the equipment. The Owner's personnel shall operate all equipment.
  - b) Pay for all fuel, power and chemicals consumed beyond quantities specified in the Contract Documents. The Contractor shall pay for fuel, power, and chemicals consumed up to the date of "certified substantial completion" except as otherwise specified herein.
4. Contractor shall be available to promptly repair all work during the startup period so as to cause minimum disruption to the total plant operation.
5. Upon completion of a minimum of ten (10) consecutive and continuous days of satisfactory operation, or the number of days called for in the Technical Specifications, the Owner will assume operation and operating cost of the equipment. If the equipment

malfunctions during this start up period, the startup period will be repeated until satisfactory operation is achieved.

6. In the event a system, equipment or component proves defective or is unable to meet specified performance criteria, the Contractor shall replace the defective item and the minimum one (1) year guarantee period, or the guarantee period called for in the Technical Specifications for the item shall start after satisfactory replacement and testing of the item.

E. Final Cleanup; Site Rehabilitation

1. Before finally leaving the site, the Contractor shall wash and clean all exposed surfaces which have become soiled or marked, and shall remove from the site of work all accumulated debris and surplus materials of any kind which result from his operation, including construction equipment, tools, sheds, sanitary enclosures, etc. The Contractor shall leave all equipment, fixtures, and work, which he has installed, in a clean condition. The completed project shall be turned over to the Owner in a neat and orderly condition.
2. The site of the work shall be rehabilitated or developed in accordance with other sections of the Specifications and the Drawings. In the absence of any portion of these requirements, the Contractor shall completely rehabilitate the site to a condition and appearance equal or superior to that which existed just prior to construction, except for those items whose permanent removal or relocation was required in the Contract Documents or ordered by the Owner.

F. Final Inspection

1. Final cleaning and repairing shall be so arranged as to be finished upon completion of the construction work. The Contractor will make his final cleaning and repairing, and any portion of the work finally inspected and accepted by the Engineer shall be kept clean by the Contractor, until the final acceptance of the entire work.
2. When the Contractor has finally cleaned and repaired the whole or any portion of the work, he shall notify the Engineer that he is ready for final inspection of the whole or a portion of the work, and the Engineer will thereupon inspect the work. If the work is not found satisfactory, the Engineer will order further cleaning, repairs, or replacement.
3. When such further cleaning or repairing is completed, the Engineer, upon further notice, will again inspect the work. The "Final Payment" will not be processed until the Contractor has complied with the requirements set forth, and the Engineer has made his final inspection of the entire work and is satisfied that the entire work is properly and satisfactorily constructed in accordance with the requirements of the Contract Documents.

G. Project Close Out

1. As construction of the project enters the final stages of completion, the Contractor shall, in concert with accomplishing the requirements set forth in the Contract Documents, attend to or have already completed the following items as they apply to his contract:
  - a) Scheduling equipment manufacturers' visits to site.
  - b) Required testing of project components.

- c) Scheduling start up and initial operation.
  - d) Scheduling and furnishing skilled personnel during initial operation.
  - e) Correcting or replacing defective work, including completion of items previously overlooked or work which remains incomplete, all as evidenced by the Engineer's "Punch" Lists.
  - f) Attend to any other items listed herein or brought to the Contractor's attention by the Engineer.
2. Just before the Engineer's Certificate of Substantial Completion is issued, the Contractor shall accomplish the cleaning and final adjustment of the various building components as specified in the Specifications and as follows:
- a) Clean all glass and adjust all windows and doors for proper operation.
  - b) Clean all finish hardware after adjustment for proper operation.
  - c) Touch up marks or defects in painted surfaces and touch up any similar defects in factory finished surfaces.
  - d) Wax all resilient flooring materials.
  - e) Remove bitumen from gravel stops, fascias, and other exposed surfaces.
  - f) Remove all stains, marks, fingerprints, soil, spots, and blemishes from all finished surfaces, tile, stone, brick, and similar surfaces.
3. In addition, and before the Certificate of Substantial Completion is issued, the Contractor shall submit to the Engineer (or to the Owner if indicated) certain records, certifications, etc., which are specified elsewhere in the Contract Documents. A partial list of such items appears below, but it shall be the Contractor's responsibility to submit any other items which are required in the Contract Documents:
- a) Test results of project components.
  - b) Performance Affidavits for equipment.
  - c) Certification of equipment or materials in compliance with Contract Documents.
  - d) Operation and maintenance instructions or manuals for equipment.
  - e) One set of neatly marked up record drawings showing as built changes and additions to the work under his Contract.
  - f) Any special guarantees or bonds (Submit to Owner).
  - g) Licensed surveyor's report showing elevations of weirs specified in the Contract Drawings and the final surveyed elevation.
4. The Contractor's attention is directed to the fact that required certifications and information under Item 3 above, must actually be submitted earlier in accordance with other Sections of the Specifications.

PART 2 – PRODUCTS  
(NOT USED)

PART 3 – EXECUTION  
(NOT USED)

- - END OF SECTION - -





## SECTION 02100

### CLEARING, GRUBBING, AND SITE PREPARATION

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. Includes all labor, material, equipment and appliances required for the complete execution of any additions, modifications, or alterations to existing building(s) and new construction work as shown on the Drawings and specified herein.
- B. Principal items of work include:
  - 1. Notifying all authorities owning utility lines running to or on the property. Protecting and maintaining all utility lines to remain and capping those that are not required in accordance with instructions of the Utility Companies, and all other authorities having jurisdiction.
  - 2. Clearing the site within the Contract Limit Lines, including removal of grass, brush, shrubs, trees, loose debris and other encumbrances except for trees marked to remain.
  - 3. Boxing and protecting all trees, shrubs, lawns and the like within areas to be preserved. Relocating trees and shrubs, so indicated on the Drawings, to designated areas.
  - 4. Repairing all injury to trees, shrubs, and other plants caused by site preparation operations shall be repaired immediately. Work shall be done by qualified personnel in accordance with standard horticultural practice and as approved by the Engineer.
  - 5. Removing topsoil to its full depth from designated areas and stockpiling on site where directed by the Engineer for future use.
  - 6. Disposing from the site all debris resulting from work under this Section.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 - Earthwork

##### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. North Carolina Administrative Code, Title 15, Chapter 2.

##### 1.04 STREET AND ROAD BLOCKAGE

- A. Closing of streets and roads during progress of the work shall be in compliance with the requirements of the Owner and other authorities having jurisdiction. Access shall be provided to all facilities remaining in operation.

## 1.05 PROTECTION OF PERSONS AND PROPERTY

- A. All work shall be performed in such a manner to protect all personnel, workmen, pedestrians and adjacent property and structures from possible injury and damage.
- B. All conduits, wires, cables and appurtenances above or below ground shall be protected from damage.
- C. Provide warning and barrier fence where shown on the Drawings and as specified herein.

## PART 2 -- EXECUTION

### 2.01 CLEARING OF SITE

- A. Before removal of topsoil, and start of excavation and grading operations, the areas within the clearing limits shall be cleared and grubbed.
- B. Clearing shall consist of cutting, removal, and satisfactory disposal of all trees, fallen timber, brush, bushes, rubbish, sanitary landfill material, fencing, and other perishable and objectionable material within the areas to be excavated or other designated areas. Prior to the start of construction, the Contractor shall survey the entire Contract site and shall prepare a plan which defines the areas to be cleared and grubbed, trees to be pruned, extent of tree pruning, and/or areas which are to be cleared but not grubbed. This plan shall be submitted to the Engineer for approval. Should it become necessary to remove a tree, bush, brush or other plants adjacent to the area to be excavated, the Contractor shall do so only after permission has been granted by the Engineer.
- C. Excavation resulting from the removal of trees, roots and the like shall be filled with suitable material, as approved by the Engineer, and thoroughly compacted per the requirements contained in Section 02200, Earthwork.
- D. Unless otherwise shown or specified, the Contractor shall clear and grub a strip at least 15 ft. wide along all permanent fence lines installed under this Contract.
- E. In temporary construction easement locations, only those trees and shrubs shall be removed which are in actual interference with excavation or grading work under this Contract, and removal shall be subject to approval by the Engineer. However, the Engineer reserves the right to order additional trees and shrubs removed at no additional cost to the Owner, if such, in his opinion, are too close to the work to be maintained or have become damaged due to the Contractor's operations.

### 2.02 STRIPPING AND STOCKPILING EXISTING TOPSOIL

- A. Existing topsoil and sod on the site within areas designated on the Drawings shall be stripped to whatever depth it may occur, and stored in locations directed by the Engineer.
- B. The topsoil shall be free of stones, roots, brush, rubbish, or other unsuitable materials before stockpiling the topsoil.
- C. Care shall be taken not to contaminate the stockpiled topsoil with any unsuitable materials.

## 2.03 GRUBBING

- A. Grubbing shall consist of the removal and disposal of all stumps, roots, logs, sticks and other perishable materials to a depth of at least 6-inches below ground surfaces.
- B. Large stumps located in areas to be excavated may be removed during grading operations, subject to the approval of the Engineer.

## 2.04 DISPOSAL OF MATERIAL

- A. All debris resulting from the clearing and grubbing work shall be disposed of by the Contractor as part of the work of this Contract. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed by the Engineer for reuse in this Project or removal by others.
- B. Burning of any debris resulting from the clearing and grubbing work will not be permitted at the site.

## 2.05 WARNING AND BARRIER FENCE

- A. The fence shall be made of a visible, lightweight, flexible, high strength polyethylene material. The fence shall be MIRASAFE as manufactured by Mirafi, Inc., or equal.

- B. Physical Properties:

### Fence:

Color:	International Orange
Roll Size:	4' x 164'
Roll weight:	34 lbs.
Mesh opening:	1-1/2" x 3"

### Posts:

ASTM Designation:	ASTM 702
Length:	5 feet long (T-Type)
Weight:	1.25 #/Foot (min)
Area of Anchor Plate:	14 Sq. In.

- C. Drive posts 12 to 18 inches into ground every 10' to 12'. Wrap fence material around first terminal post allowing overlap of one material opening. Use metal tie wire or plastic tie wrap to fasten material to itself at top, middle and bottom. At final post, cut with utility knife or scissors at a point halfway across an opening. Wrap around and tie at final post in the same way as the first post.
- D. Use tie wire or tie wrap at intermediate posts and splices as well. Thread ties around a vertical member of the fence material and the post, and bind tightly against the post. For the most secure fastening, tie at top, middle and bottom. Overlap splices a minimum of four fence openings, tie as above, fastening both edges of the fence material splice overlap.

- END OF SECTION -



## SECTION 02200

### EARTHWORK

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. Furnish all labor, equipment and materials required to complete all work associated with excavation, including off-site borrow excavation, dewatering, backfill, drainage layers beneath and around structures, foundation and backfill stone, filter fabric, embankments, stockpiling topsoil and any excess suitable material in designated areas, in place compaction of embankments, backfill and subgrades beneath foundations and roadways, excavation support, disposing from the site all unsuitable materials, providing erosion and sedimentation control grading, site grading and preparation of pavement and structure subgrade, and other related and incidental work as required to complete the work shown on the Drawings and specified herein.
- B. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Drawings or established by the Engineer.
- C. It is the intent of this Specification that the Contractor conduct the construction activities in such a manner that erosion of disturbed areas and off-site sedimentation be absolutely minimized.
- D. All work under this Contract shall be done in conformance with and subject to the limitations of the latest editions of the North Carolina Department of Transportation Standard Specifications for Roads and Structures and the North Carolina Erosion and Sediment Control Planning and Design Manual.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Requirements of related work are included in Division 1 and Division 2 of these Specifications.

##### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes, and standards refer to the most current issue available at the time of Bid.

- 1. North Carolina Department of Transportation Standard Specifications for Roads and Structures, latest edition.
- 2. American Society for Testing and Materials (ASTM):
  - ASTM C 127      Test for Specific Gravity and Absorption of Coarse Aggregate.
  - ASTM C 136      Test for Sieve Analysis of Fine and Coarse Aggregates.

ASTM D 422	Particle Size Analysis of Soils.
ASTM D 423	Test for Liquid Limit of Soils.
ASTM D 424	Test for Plastic Limit and Plasticity Index of Soils.
ASTM C 535	Test for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
ASTM D 698	Standard Method of Test for the Moisture - Density Relations of Soils Using a 5.5 lb. (2.5 kg) Rammer and a 12-inch (305 mm) Drop.
ASTM D1556	Test for Density of Soil in Place by the Sand-Cone Method.
ASTM D1557	Test for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lbs. (4.5 kg) Rammer and 18-inch (457 mm) Drop.
ASTM D2049	Test Method for Relative Density of Cohesionless Soils.
ASTM D2167	Test for Density of Soil in Place by the Rubber-Balloon Method.
ASTM D2216	Test for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.
ASTM D2487	Test for Classification of Soils for Engineering Purposes.
ASTM D2922	Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

#### 1.04 SUBSURFACE CONDITIONS

- A. Information on subsurface conditions is referenced under Division 1, General Requirements.
- B. Attention is directed to the fact that there may be water pipes, storm drains and other utilities located in the area of proposed excavation. Perform all repairs to same in the event that excavation activities disrupt service.

#### 1.05 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, the Contractor shall submit the following:
  - 1. Name and location of all material suppliers.
  - 2. Certificate of compliance with the standards specified above for each source of each material.
  - 3. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.

4. Plans and cross sections of open cut excavations showing side slopes and limits of the excavation at grade.
5. Samples of synthetic filter fabric and reinforced plastic membrane with manufacturer's certificates or catalog cuts stating the mechanical and physical properties. Samples shall be at least one (1) foot wide and four (4) feet long taken across the roll with the warp direction appropriately marked.
6. Construction drawings and structural calculations for any types of excavation support required. Drawings and calculations shall be sealed by a currently registered Professional Engineer in the State of North Carolina.
7. Monitoring plan and pre-construction condition inspection and documentation of all adjacent structures, utilities, and roadways near proposed installation of excavation support systems and near areas where dewatering is required to facilitate construction.
8. Dewatering procedures.

#### 1.06 PRODUCT HANDLING

- A. Soil and rock material shall be excavated, transported, placed, and stored in a manner so as to prevent contamination, segregation and excessive wetting. Materials which have become contaminated or segregated will not be permitted in the performance of the work and shall be removed from the site.

#### 1.07 USE OF EXPLOSIVES

- A. When the use of explosives is necessary for the prosecution of the work, the Contractor shall exercise the utmost care not to endanger life or property. The Contractor shall be responsible for any and all damage or injury to persons or property resulting from the use of explosives. Use of explosives shall be in accordance with Specification Section 02202, Excavation By Blasting.

### PART 2 -- PRODUCTS

#### 2.01 SELECT FILL

- A. Soils from the excavations meeting requirements stipulated herein with the exceptions of topsoil and organic material may be used as select fill for backfilling, constructing embankments, reconstructing existing embankments, and as structural subgrade support.
- B. Select fill used for embankment construction shall be a silty or clayey soil material with a Maximum Liquid Limit (LL) of 50 and a Plasticity Index (PI) between 7 and 20.
- C. Select fill used for backfilling shall either be material as described in Paragraph B above or a granular soil material with a Maximum Plasticity Index (PI) of 6.
- D. Regardless of material used as select fill, materials shall be compacted at a moisture content satisfactory to the Engineer, which shall be approximately that required to produce the

maximum density except that the moisture content shall not be more than 1% below nor more than 4% above the optimum moisture content for the particular material tested in accordance with the ASTM D698.

- E. Select fill used as subgrade support shall be a coarse aggregate material meeting the gradation requirements of #57 or #78 aggregates in accordance with ASTM C-33, or Aggregate Base Course (ABC) as defined in Section 02207 – Aggregate Materials.
- F. Where excavated material does not meet requirements for select fill, Contractor shall furnish off-site borrow material meeting the specified requirements herein. Determination of whether the borrow material will be paid for as an extra cost will be made based on Article 4 of the General Conditions, as amended by the Supplementary Conditions. When the excavated material from required excavations is suitable for use as backfill, bedding, or embankments, but is replaced with off-site borrow material for the Contractor's convenience, the costs associated with such work and material shall be borne by the Contractor.

## 2.02 TOPSOIL

- A. Topsoil shall be considered the surface layer of soil and sod, suitable for use in seeding and planting. It shall contain no mixture of refuse or any material toxic to plant growth.

## 2.03 FOUNDATION DRAINAGE SYSTEMS

- A. The Contractor shall provide foundation drainage systems as indicated on the Drawings and specified herein. The materials and placement shall be as indicated under Section 02712 - Foundation Drainage Systems.

## 2.04 GEOTEXTILES

- A. The Contractor shall provide geotextiles as indicated on the Drawings and specified herein. The materials and placement shall be as indicated under Section 02274 - Geotextiles.

# PART 3 -- EXECUTION

## 3.01 STRIPPING OF TOPSOIL

- A. In all areas to be excavated, filled, paved, or graveled the topsoil shall be stripped to its full depth and shall be deposited in storage piles on the site, at locations designated by the Engineer, for subsequent reuse. Topsoil shall be kept separated from other excavated materials and shall be piled free of roots and other undesirable materials.

## 3.02 EXCAVATION

- A. All material excavated, regardless of its nature or composition, shall be classified as UNCLASSIFIED EXCAVATION. Excavation shall include the removal of all soil, rock, weathered rock, rocks of all types, boulders, conduits, pipe, and all other obstacles encountered and shown to be removed within the limits of excavation shown on the Drawings or specified herein. The cost of excavation shall be included in the Lump Sum Bid Price and no additional payment will be made for the removal of obstacles encountered within the excavation limits shown on the Drawings and specified herein.



- B. Where blasting is necessary to perform the required excavations, blasting shall be performed as stipulated in Section 02202, Excavation By Blasting.
- C. All suitable material removed in the excavation shall be used as far as practicable in the formation of embankments, subgrades, and shoulders, and at such other places as may be indicated on the Drawings or indicated by the Engineer. No excavation shall be wasted except as may be permitted by the Engineer. Refer to the drawings for specific location and placement of suitable excavated materials in the formation of embankments, backfill, and structural and roadway foundations. THE ENGINEER AND/OR MATERIALS TESTING CONSULTANT WILL DESIGNATE MATERIALS THAT ARE UNSUITABLE. The Contractor shall furnish off site disposal areas for the unsuitable material. Where suitable materials containing excessive moisture are encountered above grade in cuts, the Contractor shall construct above grade ditch drains prior to the excavation of the cut material when in the opinion of the Engineer and/or materials testing consultant such measures are necessary to provide proper construction.
- D. All excavations shall be made in the dry and in such a manner and to such widths as will give ample room for properly constructing and inspecting the structures and/or piping they are to contain and for such excavation support, pumping and drainage as may be required. Excavation shall be made in accordance with the grades and details shown on the Drawings and as specified herein.
- E. Excavation slopes shall be flat enough to avoid slides that will cause disturbance of the subgrade or damage of adjacent areas. Excavation requirements and slopes shall be as indicated in the Drawings. The Contractor shall intercept and collect surface runoff both at the top and bottom of cut slopes. The intersection of slopes with natural ground surfaces, including the beginning and ending of cut slopes, shall be uniformly rounded as shown on the Drawings or as may be indicated by the Engineer. Concurrent with the excavation of cuts the Contractor shall construct intercepting berm ditches or earth berms along and on top of the cut slopes at locations shown on the Drawings or designated by the Engineer. All slopes shall be finished to reasonably uniform surfaces acceptable for seeding and mulching operations. No rock or boulders shall be left in place which protrude more than 1 foot within the typical section cut slope lines, and all rock cuts shall be cleaned of loose and overhanging material. All protruding roots and other objectionable vegetation shall be removed from slopes. The Contractor shall be required to submit plans of open-cut excavation for review by the Engineer before approval is given to proceed.
- F. It is the intent of these Specifications that all structures shall bear on an aggregate base, crushed stone or screened gravel bedding placed to the thickness shown on the Drawings, specified in these Specifications, or not less than 6-inches. Bedding for process piping shall be as specified in Section 15000 - Basic Mechanical Requirements, or as shown on the Drawings.
- G. The bottom of all excavations for structures and pipes shall be examined by the Engineer and/or materials testing consultant for bearing value and the presence of unsuitable material. If, in the opinion of the Engineer and/or materials testing consultant, additional excavation is required due to the low bearing value of the subgrade material, or if the in-place soils are soft, yielding, pumping and wet, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted select fill, and/or crushed stone or screened gravel as indicated by the Engineer. Payment for such additional work ordered by the Engineer shall be made as an extra by a Change Order in accordance with the General

Conditions and Division 1. No payment will be made for subgrade disturbance caused by inadequate dewatering or improper construction methods.

- H. All cuts shall be brought to the grade and cross section shown on the Drawings, or established by the Engineer, prior to final inspection and acceptance by the Engineer.
- I. Slides and overbreaks which occur due to negligence, carelessness or improper construction techniques on the part of the Contractor shall be removed and disposed of by the Contractor as indicated by the Engineer at no additional cost to the Owner. If grading operations are suspended for any reason whatsoever, partially completed cut and fill slopes shall be brought to the required slope and the work of seeding and mulching or other required erosion and sedimentation control operations shall be performed.
- J. Where the excavation exposes sludge, sludge contaminated soil or other odorous materials, the Contractor shall cover such material at the end of each workday with a minimum of 6-inches and a maximum of 24-inches of clean fill. The work shall be an odor abatement measure and the material shall be placed to the depth deemed satisfactory by the Engineer for this purpose.

### 3.03 EXCAVATION SUPPORT

- A. The Contractor shall furnish, place, and maintain such excavation support which may be required to support sides of excavation or to protect pipes and structures from possible damage and to provide safe working conditions. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports put in at the expense of the Contractor. The Contractor shall be responsible for the adequacy of all supports used and for all damage resulting from failure of support system or from placing, maintaining and removing it.
- B. Selection of and design of any proposed excavation support systems is exclusively the responsibility of the Contractor. Contractor shall submit drawings and calculations on proposed systems sealed by a Professional Engineer currently registered in the State of North Carolina.
- C. The Contractor shall exercise caution in the installation and removal of supports to insure that excessive or unusual loadings are not transmitted to any new or existing structure. The Contractor shall promptly repair at his expense any and all damage that can be reasonably attributed to installation or removal of excavation support system.
- D. Contractor shall monitor movement in the excavation support systems as well as movement at adjacent structures, utilities and roadways near excavation supports. Contractor shall submit a monitoring plan developed by the excavation support design engineer. All pre-construction condition assessment and documentation of adjacent structures on-site and off-site shall be performed by the Contractor. If any sign of distress such as cracking or movement occurs in any adjacent structure, utility or roadway during installation of supports, subsequent excavation, service period of supports, subsequent backfill and construction, or removal of supports, Engineer shall be notified immediately. Contractor shall be exclusively responsible for repair of any damage to any roadway, structure, utility, pipes, etc. both on-site and off-site, as a result of his operations.
- E. All excavation supports shall be removed upon completion of the work except as indicated herein. The Engineer may permit supports to be left in place at the request and expense of

the Contractor. The Engineer may order certain supports left permanently in place in addition to that required by the Contract. The cost of the materials so ordered left in place, less a reasonable amount for the eliminated expense of the removal work omitted, will be paid as an extra by a Change Order in accordance with the General Conditions and Division 1. Any excavation supports left in place shall be cut off at least two (2) feet below the finished ground surface or as directed by the Engineer.

### 3.04 PROTECTION OF SUBGRADE

- A. To minimize the disturbance of bearing materials and provide a firm foundation, the Contractor shall comply with the following requirements:
  - 1. Use of heavy rubber-tired construction equipment shall not be permitted on the final subgrade unless it can be demonstrated that drawdown of groundwater throughout the entire area of the structure is at least 3 feet below the bottom of the excavation (subgrade). Even then, the use of such equipment shall be prohibited should subgrade disturbance result from concentrated wheel loads.
  - 2. Subgrade soils disturbed through the operations of the Contractor shall be excavated and replaced with compacted select fill or crushed stone at the Contractor's expense as indicated by the Engineer.
  - 3. The Contractor shall provide positive protection against penetration of frost into materials below the bearing level during work in winter months. This protection can consist of a temporary blanket of straw or salt hay covered with a plastic membrane or other acceptable means.

### 3.05 PROOFROLLING

- A. The subgrade of all structures and all areas that will support pavements or select fill shall be proofrolled. After stripping of topsoil, excavation to subgrade and prior to placement of fills, the exposed subgrade shall be carefully inspected by probing and testing as needed. Any topsoil or other organic material still in place, frozen, wet, soft, or loose soil, and other undesirable materials shall be removed. The exposed subgrade shall be proofrolled with a heavily loaded tandem-wheeled dump truck to check for pockets of soft material hidden beneath a thin crust of better soil. Any unsuitable materials thus exposed shall be removed and replaced with an approved compacted material.

### 3.06 DEWATERING

- A. The Contractor shall do all dewatering as required for the completion of the work. Procedures for dewatering proposed by the Contractor shall be submitted to the Engineer for review prior to any earthwork operations. All water removed by dewatering operations shall be disposed of in accordance with the North Carolina Sedimentation Pollution Control Act.
- B. The dewatering system shall be of sufficient size and capacity as required to control groundwater or seepage to permit proper excavation operations, embankment construction and reconstruction, subgrade preparation, and to allow concrete to be placed in a dry condition. The system shall include a sump system or other equipment, appurtenances and other related earthwork necessary for the required control of water. The Contractor shall drawdown groundwater to at least 3 feet below the bottom of excavations (subgrade) at all times in order to maintain a dry and undisturbed condition.

- C. The Contractor shall control, by acceptable means, all water regardless of source. Water shall be controlled and its disposal provided for at each berm, structure, etc. The entire periphery of the excavation areas shall be ditched and diked to prevent water from entering the excavation. The Contractor shall be fully responsible for disposal of the water and shall provide all necessary means at no additional expense to the Owner. The Contractor shall be solely responsible for proper design, installation, proper operation, maintenance, and any failure of any component of the system.
- D. The Contractor shall be responsible for and shall repair without cost to the Owner, any damage to work in place and the excavation, including damage to the bottom due to heave and including removal of material and pumping out of the excavated area. The Contractor shall be responsible for damages to any other area or structure caused by his failure to maintain and operate the dewatering system proposed and installed by the Contractor.
- E. The Contractor shall take all the steps that he considers necessary to familiarize himself with the surface and subsurface site conditions, and shall obtain the data that is required to analyze the water and soil environment at the site and to assure that the materials used for the dewatering systems will not erode, deteriorate, or clog to the extent that the dewatering systems will not perform properly during the period of dewatering. Copies of logs of borings and laboratory test results are available to the Contractor. This data is furnished for information only, and it is expressly understood that the Owner and Engineer will not be held responsible for any interpretations or conclusions drawn therefrom by the Contractor.
- F. Prior to the execution of the work, the Contractor, Owner and Engineer shall jointly survey the condition of adjoining structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.

### 3.07 EMBANKMENTS

- A. The Contractor shall perform the construction of embankments in such a manner that cut and fill slopes will be completed to final slopes and grade in a continuous operation. The operation of removing excavation material from any cut and the placement of embankment in any fill shall be a continuous operation to completion unless otherwise permitted by the Engineer.
- B. Surfaces upon which embankments are to be constructed shall be stripped of topsoil, organic material, rubbish and other extraneous materials. After stripping and prior to placing embankment material, the Contractor shall compact the top 12-inches of in place soil as specified under Paragraph 3.09, COMPACTION.
- C. Any soft or unsuitable materials revealed before or during the in place compaction shall be removed as indicated by the Engineer and/or materials testing consultant and replaced with select fill.
- D. Ground surfaces on which embankment is to be placed, shall be scarified or stepped in a manner which will permit bonding of the embankment with the existing surface. The embankment soils shall be as specified under Part 2 - Products, and shall be deposited and spread in successive, uniform, approximately horizontal layers not exceeding 8-inches in compacted depth for the full width of the cross section, and shall be kept approximately level by the use of effective spreading equipment. Hauling shall be distributed over the full width

of the embankment, and in no case will deep ruts be allowed to form during the construction of the embankment. The embankment shall be properly drained at all times. Each layer of the embankment shall be thoroughly compacted to the density specified under Paragraph 3.09, COMPACTION.

- E. The embankment or fill material in the layers shall be of the proper moisture content before rolling to obtain the prescribed compaction. Wetting or drying of the material and manipulation when necessary to secure a uniform moisture content throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, all work on all portions of the embankment thus affected shall be delayed until the material has dried to the required moisture content. Samples of all embankment materials for testing, both before and after placement and compaction, will be taken at frequent intervals. From these tests, corrections, adjustments, and modifications of methods, materials, and moisture content will be made to construct the embankment.
- F. Where embankments are to be placed and compacted on hillsides, or when new embankment is to be compacted against embankments, or when embankment is built in part widths, the slopes that are steeper than 4:1 shall be loosened or plowed to a minimum depth of 6 inches or, if in the opinion of the Engineer, the nature of the ground is such that greater precautions should be taken to bind the fill to the original ground then benches shall be cut in the existing ground as indicated by Engineer.
- G. When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portions of the embankments and the other material which meets the requirements for select fill shall be incorporated into the formation of the embankments. Stones or fragmentary rock larger than 4-inches in their greatest dimension will not be allowed within the top 6-inches of the final grade. Stones, fragmentary rock, or boulders larger than 12-inches in their greatest dimension will not be allowed in any portions of embankments and shall be disposed of by the Contractor as indicated by the Engineer. When rock fragments or stone are used in embankments, the material shall be brought up in layers as specified or directed and every effort shall be exerted to fill the voids with finer material to form a dense, compact mass which meets the densities specified for embankment compaction.

### 3.08 BACKFILLING

- A. All structures and pipes shall be backfilled with the type of materials shown on the Drawings and specified herein. Select fill shall be deposited in successive, uniform, approximately horizontal layers not exceeding 8-inches in compacted depth for the full width. Stones or fragmentary rock larger than 4-inches in their greatest dimension will not be allowed within the top 6-inches of the ground nor within 6 inches of pipes. No stone or fragmentary rock larger than 12-inches in their greatest dimension will be allowed for any portion of backfill. Compaction shall be in accordance with the requirements of Paragraph 3.09, COMPACTION.
- B. Where excavation support is used, the Contractor shall take all reasonable measures to prevent loss of support beneath and adjacent to pipes and existing structures when supports are removed. If significant volumes of soil cannot be prevented from clinging to the extracted supports, the voids shall be continuously backfilled as rapidly as possible. The Contractor shall thereafter limit the depth below subgrade that supports will be installed in similar soil conditions or employ other appropriate means to prevent loss of support.

### 3.09 COMPACTION

- A. The Contractor shall compact embankments, backfill, crushed stone, aggregate base, and in place subgrade in accordance with the requirements of this Section. The densities specified herein refer to percentages of maximum density as determined by the noted test methods. Compaction of materials on the project shall be in accordance with the following schedule:

	Density % Std. Proctor (D698)	Density % Mod. Proctor (D1557)	Max. Lift Thickness as Compacted Inches
Embankments Beneath Structures*	98	95	8
Other Embankments	95	92	8
Backfill Around Structures	95	92	8
Backfill in Pipe Trenches	95	92	8
Crushed Stone Beneath Structures	**	**	12
Select Sand	--	98	8
Aggregate Base Course (ABC) Beneath Pavements and Structures	--	98	8
Crushed Stone Backfill	**	**	12
Crushed Stone Pipe Bedding	**	**	12
In place Subgrade Beneath Structures	98	95	Top 12-inches

\* Embankments beneath structures shall be considered to include a zone 10 feet out from the foundation of the structure extending down to the natural ground on a 45° slope.

\*\* The aggregate shall be compacted to a degree acceptable to the Engineer by use of a vibratory compactor and/or crawler tractor.

- B. Field density tests will be made by the materials testing consultant to determine if the specified densities have been achieved, and these tests shall be the basis for accepting or rejecting the compaction. In-place density tests will be performed in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. The Engineer in conjunction with the materials testing consultant will be the judge as to which test method will be the most appropriate. Failure to achieve the specified densities shall require the Contractor to re-compact the material or remove it as required. The Contractor shall, if necessary, increase his compactive effort by increasing the number of passes, using heavier or more suitable compaction equipment, or by reducing the thickness of the layers. The Contractor shall adjust the moisture contents of the soils to bring them within the optimum range by drying them or adding water as required.
- C. Testing will be performed as frequently as deemed necessary by the Engineer and/or materials testing consultant. As a minimum, one in-place density test shall be performed for each 1000 cubic yards of embankment placed and 500 cubic yards of backfill placed or one test performed each day for either.

### 3.10 REMOVAL OF EXCESS AND UNSUITABLE MATERIALS

- A. The Contractor shall remove and dispose of off-site all unsuitable materials. Within thirty (30) consecutive days after Notice to Proceed, the Contractor shall submit to the Engineer for review all required permits and a list of disposal sites for the unsuitable materials. If the disposal site is located on private property, the submittal shall also include written permission from the owner of record.
- B. All unsuitable materials shall be disposed of in locations and under conditions that comply with federal, state and local laws and regulations.
- C. The Contractor shall obtain an off-site disposal area prior to beginning demolition or excavation operations.
- D. All excess and unsuitable materials shall be hauled in trucks of sufficient capacity and tight construction to prevent spillage. Trucks shall be covered to prevent the propagation of dust.
- E. When all excess and unsuitable material disposal operations are completed, the Contractor shall leave the disposal sites in a condition acceptable to the Owner and Owner(s) of the disposal site(s).

### 3.11 BORROW EXCAVATION

#### A. Description

The work covered by this section consists of the excavation of approved material from borrow sources and the hauling and utilization of such material as required on the Drawings or directed by the Engineer. It shall also include the removing, stockpiling, and replacement of topsoil on the borrow source; the satisfactory disposition of material from the borrow source which is not suitable for use; and the satisfactory restoration of the borrow source and haul roads to an acceptable condition upon completion of the work.

Borrow excavation shall not be used before all available suitable unclassified excavation has been used for backfill and incorporated into the embankments.

#### B. Coordination with Seeding Operations

The Contractor shall coordinate the work covered by this section with the construction of embankments so that the requirements of Section 02200 are met.

#### C. Materials

All material shall meet the requirements of Division 2 shown below:

Borrow Material.....Section 02200, Subsection 2.01 - Select Fill

#### D. Construction Methods

##### 1. General

The surface of the borrow area shall be thoroughly cleared and grubbed and cleaned of all unsuitable material including all organics, topsoil, etc., before beginning the

excavation. Disposal of material resulting from clearing and grubbing shall be in accordance with Section 02100.

Each borrow operation shall not be allowed to accumulate exposed, erodible slope area in excess of 1 acre at any one given time without the Contractor's beginning permanent seeding and mulching of the borrow source or other erosion control measures as may be approved by the Engineer.

The topsoil shall be removed and stockpiled at locations that will not interfere with the borrow operations and that meet the approval of the Engineer. Temporary erosion control measures shall be installed as may be necessary to prevent the erosion of the stockpile material. Once all borrow has been removed from the source or portion thereof, the stockpiled topsoil shall be spread uniformly over the source.

Where it is necessary to haul borrow material over existing roads, the Contractor shall use all necessary precautions to prevent damage to the existing roads. The Contractor shall also conduct his hauling operations in such a manner as to not interfere with the normal flow of traffic and shall keep the traffic lanes free from spillage at all times.

## 2. Owner Furnished Sources

Where borrow sources are furnished by the Owner the location of such sources will be as designated on the Drawings or as directed by the Engineer.

The Owner will furnish the necessary haul road right-of-way at locations designated by the Engineer. All haul roads required shall be built, maintained, and when directed by the Engineer, obliterated, at no cost to the Owner. Where the haul road is to be reclaimed for cultivation the Contractor shall plow or scarify the area to a minimum depth of 8 inches.

The borrow sources shall be left in a neat and presentable condition after use. All slopes shall be smoothed, rounded, and constructed not steeper than 3:1. Where the source is to be reclaimed for cultivation the source shall be plowed or scarified to a minimum depth of 8 inches, disc harrowed, and terraces constructed. The source shall be graded to drain such that no water will collect or stand and a functioning drainage system shall be provided.

All sources shall be seeded and mulched in accordance with Section 02910.

## 3. Contractor Furnished Sources

Prior to the approval of any off-site borrow source(s) developed for use on this project, the Contractor shall obtain certification from the State Historic Preservation Officer of the State Department of Cultural Resources certifying that the removal of the borrow material from the borrow source(s) will have no effect on any known district, site building, structure, or object that is included or eligible for inclusion in the National Register of Historic Places. A copy of this certification shall be furnished to the Engineer prior to performing any work on the proposed borrow source.



The approval of borrow sources furnished by the Contractor shall be subject to the following conditions:

- a. The Contractor shall be responsible for acquiring the right to take the material and any rights of access that may be necessary; for locating and developing the source; and any clearing and grubbing and drainage ditches necessary.

Such right shall be in writing and shall include an agreement with the Owner that the borrow source may be dressed, shaped, seeded, mulched, and drained as required by these Specifications after all borrow has been removed.

- b. Except where borrow is to be obtained from a commercial source, the Contractor and the property owner shall jointly submit a borrow source development, use, and reclamation plan to the Engineer for his approval prior to engaging in any land disturbing activity on the proposed source other than material sampling that may be necessary. The Contractor's plan shall address the following:

- (1) Drainage

The source shall be graded to drain such that no water will collect or stand and a functioning drainage system shall be provided. If drainage is not practical, and the source is to serve as a pond, the minimum average depth below the water table shall be 4 feet or the source graded so as to create wetlands as appropriate.

- (2) Slopes

The source shall be dressed and shaped in a continuous manner to contours which are comparable to and blend in with the adjacent topography, but in no case will slopes steeper than 3:1 be permitted.

- (3) Erosion Control

The plan shall address the temporary and permanent measures that the Contractor intends to employ during use of the source and as a part of the reclamation. The Contractor's plan shall provide for the use of staged permanent seeding and mulching on a continual basis while the source is in use and the immediate total reclamation of the source when no longer needed.

- 4. Maintenance

During construction and until final acceptance the Contractor shall use any methods approved by the Engineer which are necessary to maintain the work covered by this section so that the work will not contribute to excessive soil erosion.

- END OF SECTION -



SECTION 02207  
AGGREGATE MATERIALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, equipment and materials required to complete all work associated with the installation of aggregate material beneath foundations, as backfill and as roadway subgrades and other related and incidental work as required to complete the work shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01090 - Reference Standards
- B. Section 02200 - Earthwork
- C. Section 02276 - Erosion and Sedimentation Control
- D. Section 02510 - Paving and Surfacing
- E. Section 02712 - Foundation Drainage Systems
- F. Section 02910 - Final Grading and Landscaping

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
  - 1. North Carolina Department of Transportation (NCDOT) Standard Specifications for Roads and Structures; South Carolina State Highway Department Standard Specifications for Highway Construction.
  - 2. ASTM C 127 Test for Specific Gravity and Absorption of Coarse Aggregate.
  - 3. ASTM C 136 Test for Sieve Analysis of Fine and Coarse Aggregates.
  - 4. ASTM C 535 Test for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
  - 1. Materials gradation and certification.

2. ASTM C127, ASTM C136, and ASTM C535 test results

## PART 2 -- PRODUCTS

### 2.01 CRUSHED STONE, SCREENED GRAVEL and AGGREGATE BASE COURSE (ABC)

- A. Crushed stone or screened gravel shall meet the requirements of Aggregate Standard Size No. 57 or No. 67 as defined by NCDOT Standard Specifications.
- B. ABC shall meet the requirements of ABC as defined by NCDOT Standard Specifications.

### 2.02 SELECT SAND

- A. Select sand shall meet the requirements of Sections 1005 and 1014 of the NCDOT Standard Specifications for materials and gradation. The size used shall be Standard Size No. 2S or 2MS as listed and defined in Table 1005-2, "Aggregate Gradation", of the NCDOT Standard Specifications.

## PART 3 -- EXECUTION

### 3.01 CRUSHED STONE, SCREENED GRAVEL AND AGGREGATE BASE COURSE (ABC)

- A. Contractor shall install crushed stone, screened gravel and ABC in accordance with the NCDOT Standard Specifications and as shown on the Drawings and indicated in the Contract Documents.
  1. Unless otherwise stated herein or shown on the Drawings, all mat foundations (bottom slabs) for the proposed structures shall have a blanket of crushed stone or ABC 6-inches thick minimum placed directly beneath the proposed mat. The blanket shall extend a minimum of 12 inches beyond the extremities of the mat.
  2. For subgrade preparation at structures and structural fill, the foundation material shall be ABC where specifically specified on Drawings, otherwise, crushed stone or screened gravel shall be used.
  3. For ground under drains, pipe bedding, and drainage layers beneath structures the coarse aggregate shall meet the requirements of aggregate standard Size No. 57 or No. 67, as defined by NCDOT Standard Specifications.

### 3.02 SELECT SAND

- A. Contractor shall install select sand in accordance with the NCDOT Standard Specifications and as shown on the Drawings and indicated in the Contract Documents.

- END OF SECTION -

## SECTION 02276

### EROSION AND SEDIMENTATION CONTROL

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENTS

- A. The Contractor is responsible for implementing Best Management Practices (BMPs) to prevent and minimize erosion and resultant sedimentation in all cleared and grubbed areas during and after construction. This item covers the work necessary for the installation of structures and measures for the prevention of soil erosion and control of sedimentation. The Contractor shall furnish all material, labor and equipment necessary for the proper installation, maintenance, inspection, monitoring, reporting, and removal (where applicable) of erosion prevention and sediment control measures and, if applicable, to cause compliance with all local permits and the State of North Carolina Department of Environment and Natural Resources Division of Water Quality General Permit – NCG 010000 to Discharge Stormwater under the National Pollution Discharge Elimination System for Construction Activities, for any land disturbance or construction activity of one (1) acre or more, under this Section 02276.
- B. Any land disturbance as the result of modifications to a site's drainage features or topography requires protection from erosion and sedimentation.
- C. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Contract Drawings or established by the Engineer.
- D. It is the intent of this Specification that the Contractor conducts the construction activities in such a manner that erosion of disturbed areas and off site sedimentation be absolutely minimized.
- E. All work under this Contract shall be done in conformance with and subject to the limitations of the North Carolina Rules and Regulations for Erosion and Sedimentation Control as adopted by the North Carolina Sedimentation Control Commission (15A NCAC, Chapter 4, latest edition).
- F. The following excerpts from the regulations are particularly important:
  - 1. Pursuant to North Carolina G.S. 113A-57(2), the angle of graded slopes and fills shall be no greater than the angle that can be retained by vegetative cover or other adequate erosion-control devices or structures.
  - 2. As per North Carolina DWQ Construction General Permit NCG01, perimeter dikes, swales, ditches and slopes, disturbed areas within High Quality Water (HWQ) Zones, and slopes steeper than 3H:1V following completion of any phase of grading, shall be planted or otherwise provided with temporary or permanent ground cover, devices, or structures sufficient to restrain erosion within 7 calendar days.

3. All other slopes of 3H:1V or flatter, except those with slopes greater than 50 feet in length or within HWQ Zones, following completion of any phase of grading, shall be planted or otherwise provided with temporary or permanent ground cover, devices, or structures sufficient to restrain erosion within 14 calendar days.
  - G. Due to the nature of the work required by this Contract, it is anticipated that the location and nature of the erosion and sediment control devices will be adjusted on several occasions to reflect the current phase of construction. The construction schedule adopted by the Contractor will impact the placement and need for specific devices required for the control of erosion. The Contractor shall develop and implement such additional techniques as may be required to minimize erosion and off-site sedimentation. The location and extent of erosion and sedimentation control devices shall be revised at each phase of construction that results in a change in either the quantity or direction of surface runoff from constructed areas. All deviations from the erosion and sedimentation control provisions shown on the Contract Drawings shall have the prior acceptance of the Engineer and shall be completed at no additional cost to the Owner.
  - H. Erosion and sedimentation controls applicable to this project shall be as shown on the Contract Drawings, as specified herein, as indicated by the Engineer and as detailed in the North Carolina Erosion and Sediment Control Planning and Design Manual.
- 1.02 RELATED WORK SPECIFIED ELSEWHERE
- A. Section 01300 – Submittals
  - B. Section 02100 – Clearing, Grubbing, and Site Preparation
  - C. Section 02140 – Dewatering
  - D. Section 02200 – Earthwork
  - E. Section 02274 – Geotextiles
  - F. Section 02500 – Surface Restoration
  - G. Section 02910 – Final Grading and Landscaping
- 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS
- A. Without limiting the generality of other requirements of these specifications, all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section.
    1. 15A NCAC, Chapter 4
    2. North Carolina Erosion and Sediment Control Planning and Design Manual, latest edition
    3. North Carolina Department of Environment and Natural Resources General Permit NCG 010000 to Discharge Stormwater under the National Pollution Discharge

Elimination System for Construction Activities, for any land disturbance or construction activity of one (1) acre or more

4. North Carolina Department of Transportation Standard Specifications for Roads and Structures, latest edition
5. North Carolina Division of Water Quality Stormwater Best Management Practices Manual, latest edition

B. See Specification Section 01090 - Reference Standards.

#### 1.04 REGULATORY COMPLIANCE

A. Land disturbance activities are not authorized to begin until after all required erosion and sediment control permits are obtained from the United States, the State of North Carolina and local authorities, as necessary. Contractor is the Co-Primary Permittee and Operator under the provisions of the NPDES Permit. As such, the Contractor will be required to sign certain certifications as described in the NPDES Permit. Contractor shall comply with requirements specified in the Contract Documents, on the approved Erosion Control Plan, and by the Engineer. Contractor shall also comply with all other laws, rules, regulations, ordinances and requirements concerning soil erosion and sediment control established in the United States, the State of North Carolina and local authorities as applicable. The following documents and the documents referenced therein define the regulatory requirements for this Section 02276.

1. NPDES PERMIT: The North Carolina Department of Environment and Natural Resources General Permit NCG 010000 to Discharge Stormwater under the National Pollution Discharge Elimination System for Construction Activities (NPDES permit) governs land disturbance or construction activities of one (1) acre or more. On applicable sites, Contractor is responsible for complying with terms and conditions of this permit.
2. Manual for Erosion and Sediment Control: Contractor shall follow Practices and Standards of the North Carolina Erosion and Sediment Control Planning and Design Manual (NC ESCPDM), latest edition.

B. During the period beginning on the effective date of the permit and lasting until expiration, the Permittee is authorized to discharge stormwater associated with construction activity including clearing, grading and excavation activities resulting in the disturbance of land and related support activities. Such discharges shall be controlled, limited and monitored as specified below.

1. The Contractor, as Co-Primary Permittee and Operator under the provisions of the NPDES Permit, shall submit a plan for compliance with the Owner-provided approved erosion and sedimentation control plan to the Engineer for approval. Plans must include designation of where 7 and 14-day ground stabilization requirements and where basins which comply with surface-withdrawal requirements of the NPDES permit, if applicable, are located. Land disturbing activity shall not commence until the plan is approved by the Engineer. Maintain an up-to-date copy of the approved plan on the site.

2. Implement the approved plan. Deviation from the plan is allowed only to correct emergency situations of sediment discharge offsite or when minor modifications are made to improve performance of the measures and the approval authority has been notified. Note allowed deviations on the plan maintained on the site.
3. Manage onsite activities such that no adverse impacts to water quality occur from site activities or allowed discharges. The following activities, and others on a site-specific basis, require oversight throughout the construction and development process to assure that all water quality standards are protected.
  - a. Equipment Operation and Maintenance: Equipment utilized during the construction activity on a site must be operated and maintained in such a manner as to prevent the potential or actual pollution of the surface or ground waters of the State. Fuels, lubricants, coolants, and hydraulic fluids, or any other petroleum products, shall not be discharged onto the ground or into surface waters. Spent fluids shall be disposed of in a manner so as not to enter the waters, surface or ground, of the State and in accordance with applicable state and federal disposal regulations. Any spilled fluids shall be cleaned up to the extent practicable and disposed of in a manner so as not to allow their entry into the waters, surface or ground, of the State.
  - b. Material Handling: Herbicide, pesticide, and fertilizer usage during the construction activity shall be consistent with the Federal Insecticide, Fungicide, and Rodenticide Act and shall be in accordance with label restrictions.
  - c. Building Material Waste Handling: All wastes composed of building materials shall be disposed of in accordance with North Carolina General Statutes, Chapter 130A, Article 9 - Solid Waste Management, and rules governing the disposal of solid waste (North Carolina Administrative Code Section 15A NCAC 13B). In particular, the following guidelines shall be followed:
  - d. No paint or liquid wastes in streams or storm drains.
  - e. Dedicated area for demolition, construction, and other wastes must be located a minimum of 50' from storm drains and streams unless no reasonable alternatives are available.
  - f. Earthen-material stockpiles must be located a minimum of 50' from storm drains and streams unless no reasonable alternatives are available.
  - g. Concrete materials onsite, including excess concrete, must be controlled to avoid contact with surface waters, wetlands, or buffers. (Note discharges from onsite concrete plants may require coverage under a separate NPDES permit – NCG140000). No concrete washout onsite is allowed.
  - h. Litter and Sanitary Waste: The Permittee shall control the management and disposal of litter and sanitary waste from the site.

C. Violations and Fines



1. Contractor shall be responsible for reimbursing the Owner for any fines incurred as a result of violations to the NC Sedimentation Pollution Control Act, the NPDES General Permit for Stormwater Discharges on Construction Sites, and any applicable delegated local program's sediment control regulations until construction activities are complete and the project is accepted by the Owner. These include fines levied by the NCDENR Division of Land Quality, NCDENR Division of Water Quality and delegated local programs.
2. If violations result in the issuance of a Notice of Violation, the Contractor shall comply with the requirements of the Notice within the specified time period for compliance. Failure to comply could result in the assessment of a penalty for each day of the continuing violation, beginning with the date of the violation.
3. Violations may result in civil and/or criminal penalties which include fines and imprisonment.

#### 1.05 SUBMITTALS

- A. Prior to the start of the work, the Contractor shall prepare and submit a plan for implementing the temporary and permanent erosion and sedimentation control measures as shown on the Erosion and Sediment Control Plan approved by the appropriate regulatory authority. Construction work shall not commence until the schedule of work and the methods of operations have been reviewed and approved.
- B. The Contractor shall perform inspections of erosion and sedimentation control measures and stormwater discharge outfalls and prepare inspection reports as described in Part 3 of this Section. Copies of the inspection reports shall be submitted to the Engineer on a monthly basis.
- C. In accordance with the procedures and requirements set forth in the General Conditions Division 1 and Section 01300 - Submittals, the Contractor shall submit the following:
  1. Name and location of all material suppliers.
  2. Certificate of compliance with the standards specified above for each source of each material.
  3. List of disposal sites for waste and unsuitable materials and evidence of all required permits for use of those sites.

#### 1.06 GUARANTEE

- A. All restoration and re-vegetation work shall be subject to the one-year guarantee period of the Contract as specified in the General Conditions.

## PART 2 – MATERIALS

### 2.01 MATERIALS

- A. Materials for use in erosion and sedimentation control devices shall be in accordance with the NC ESCPDM.
- B. All erosion and sediment control bid prices shall include all excavation, grading, maintenance, legal sediment disposal, permits and all other work and appurtenances necessary to design, install and maintain the sediment and erosion control measures as detailed herein and in accordance with the NC ESCPDM.

### 2.02 SILT FENCE

- A. Silt (or sediment) fence shall be constructed as shown on the Contract Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in Section 6.62 of the NC ESCPDM. Silt fences shall be installed below small disturbed areas that are less than ¼ acre disturbed per 100-feet of fence when slopes are less than 2%. Contractor shall refer to Table 6.62a in the NC ESCPDM for criteria. Silt fence shall not be installed across streams, ditches, or waterways or other areas of concentrated flows.
- B. Silt fence shall be designed, installed and maintained in accordance with Part 3 of this Section and Section 6.62 of the NC ESCPDM. Silt fence shall be a woven geotextile filter fabric made specifically for sediment control. Filter fabric shall not rot when buried and shall resist attack from soil chemicals, alkalines and acids in the pH range from 2 to 13, and shall resist damage due to prolonged ultraviolet exposure. Filter fabric shall be C-50NW as manufactured by Contech Earth Stabilization Solutions, GT 142 as manufactured by SKAPS Industries, Soiltex ST 120N as manufactured by Geo-Synthetics, Inc., or approved equal. The cost of silt fence shall include the materials, excavation, backfill, aggregate, etc. and all maintenance and restoration activities required.
- C. Silt fence shall be stable for the 10-year peak storm runoff. Fabric shall meet the following specifications:

<b>Temporary Silt Fence Material Property Requirements</b>					
	<b>Test Material</b>	<b>Units</b>	<b>Supported<sup>1</sup> Silt Fence</b>	<b>Un-Supported<sup>1</sup> Silt Fence</b>	<b>Type of Value</b>
Grab Strength	ASTM D 4632	N (lbs)			
Machine Direction			400	550	MARV
			(90)	(90)	
x-Machine Direction			400	450	MARV
			(90)	(90)	
Permittivity <sup>2</sup>	ASTM D 4491	sec-1	0.05	0.05	MARV
Apparent Opening Size <sup>2</sup>	ASTM D 4751	mm	0.60	0.60	Max. ARV <sup>3</sup>
		(US Sieve #)	(30)	(30)	
Ultraviolet Stability	ASTM D 4355	% Retained Strength	70% after 500 hours exposure	70% after 500 hours exposure	Typical

<sup>1</sup> Silt Fence support shall consist of 14 gage steel wire with a mesh spacing of 150 mm (6 inches), or prefabricated polymer mesh of equivalent strength.

<sup>2</sup> These default values are based on empirical evidence with a variety of sediment. For environmentally sensitive areas, a review of previous experience and/or site or regionally specific geotextile tests in accordance with Test Method D 5141 should be performed by the agency to confirm suitability of these requirements.

<sup>3</sup> As measured in accordance with Test Method D 4632.

- D. The synthetic filter fabric shall consist of at least 95% by weight of polyolefins or polyester, certified by the manufacturer, and as specified by Section 6.62 of the NC ESCPDM.
- E. The posts for silt fences shall be 1.33 lb/linear feet steel with a minimum length of 5 feet; posts shall have projections to facilitate fastening of the fabric.
- F. For reinforcement of standard strength filter fabric use wire fence with a minimum 14 gauge and a maximum mesh spacing of 6 inches.

## 2.03 STONE FOR EROSION CONTROL

- A. The Contractor shall place stone for erosion control as shown on the Contract Drawings, as specified herein, as specified in Section 1610 of the NCDOT Standard Specifications, and as detailed in Section 6.15 of the NC ESCPDM. The stone for erosion control shall consist of field stone or rough un-hewn quarry stone. The stone shall be sound, tough, dense, and resistant to the action of air and water. The stone for erosion control shall be Class (A) or Class (B) as specified in the NCDOT Standard Specifications, Section 1610, unless otherwise shown on the Contract Drawings.
- B. Stone for erosion control shall be designed, installed and maintained in accordance with Part 3 of this Section, Section 1610 of the NCDOT Standard Specifications, and Section 6.15 of the NC ESCPDM. The cost for stone for erosion control shall include furnishing, weighing, stockpiling, re-handling, placing and maintaining stone; disposal of any stone not incorporated into the project if directed by the Engineer; and any other incidentals necessary to complete the work.

## 2.04 RIP RAP

- A. The Contractor shall place rip rap as shown on the Contract Drawings, as specified in Section 1042 of the NCDOT Standard specifications for plain rip rap, and as detailed in Section 6.15 of the NC ESCPDM. The stone for rip rap shall consist of field stone or rough un-hewn quarry stone. The rip rap shall be sound, tough, dense, and resistant to the action of air and water. Neither the width nor thickness of individual stones shall be less than one third their length. The rip rap shall be Class 1 or Class 2 as specified in the NCDOT Standard Specifications, Section 1042, unless otherwise shown on the Contract Drawings.
- B. Rip rap shall be designed, installed and maintained in accordance with Part 3 of this Section, Section 1042 of the NCDOT Standard Specifications, and Section 6.15 of the NC ESCPDM. The cost for rip rap shall include furnishing, weighing, stockpiling, rehandling, placing and maintaining rip rap; disposal of any rip rap not incorporated into

the project if directed by the Engineer; and any other incidentals necessary to complete the work.

## 2.05 ROLLED EROSION CONTROL PRODUCTS (RECPS)

- A. RECPS, including Turf Reinforcement Mat (TRM), shall be installed as shown on the Contract Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in Section 6.17 of the NC ESCPDM. RECPS should be utilized to aid stabilization of slopes greater than 2:1 and with more than 10 feet of vertical relief. RECPS should also be used when mulch cannot be adequately tacked and where immediate ground cover is required to prevent erosion damage. Examples of RECPS are blankets, nets and matting.
- B. RECPS shall be designed, installed and maintained in accordance with Part 3 of this Section and Section 6.17 of the NC ESCPDM. The cost for RECPS shall include all excavation, grading, and materials, and all maintenance activities.
- C. RECPS shall be used to aid in permanent stabilization of vegetated channels where runoff velocity will exceed 2 feet/second on bare earth during the 2-year rainfall event that produces peak runoff.
- D. RECPS shall be chosen based on the Design Criteria detailed in Section 6.17 of the NC ESCPDM. Typically, nets shall be used in conjunction with mulch; the use of mulch is typically not required with excelsior, woven straw blankets and coir blankets.
- E. The recommended anchoring devices are 12-inch minimum length wooden stakes, 11-gauge staples that are at least 6 inches long by 1 inch wide, or rigid, biodegradable stakes of a minimum of 6 inches in length. If Manufacturer's recommendations are more stringent, they shall supersede.
- F. The minimum bare soil shear stress values for specific RECPS are as follows:
  - 1. Straw with net temporary RECP shall be North American Green S150, American Excelsior Co. Curlex I, Contech SFB1, or equal with a minimum bare soil shear stress value of 1.5 lb/ft<sup>2</sup>.
  - 2. Curled wood or coconut fiber RECP shall be American Excelsior Curlex II, North American Green C125, Contech EFB4 or equal matting with a minimum bare soil shear stress value of 2.0 lb/ft<sup>2</sup>.
  - 3. Synthetic Turf Reinforcement Mat (TRM) shall be Enkamat 7020 as manufactured by Colbond Geosynthetics, Synthetic Industries Landlock Erosion Mat TRM 1060, TH8 as manufactured by TC Mirafi, or equal matting with a minimum long-term vegetated shear stress value of 5.0 lb/ft<sup>2</sup>.

## 2.06 TEMPORARY AND PERMANENT DIVERSIONS

- A. Temporary diversions shall be constructed as shown on the Contract Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in Sections 6.20 and 8.05 of the NC ESCPDM. Permanent diversions shall be constructed as shown on

the Contract Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in Section 6.21 and 8.05 of the NC ESCPDM. Temporary diversions shall be constructed adjacent to disturbed areas to collect surface runoff from disturbed areas and direct the runoff to sediment basins or to divert non-sediment laden runoff away from undisturbed areas and/or sediment basins. All temporary diversions transporting sediment-laden runoff shall terminate in a sediment trapping device. Permanent diversions should be planned as a part of initial site development and should be coordinated with temporary diversions. All temporary and permanent diversions shall be stabilized with vegetation or other means within 7 days of installation. Permanent diversions shall be used to divert water to locations where it can be used or released without erosion or flood damage. Dimensions shall be as shown on the Contract Drawings.

- B. Temporary diversions shall be designed, installed and maintained in accordance with Part 3 of this Section and Sections 6.20 and 8.05 of the NC ESCPDM, to the satisfaction of the Engineer, until the site has been stabilized. Permanent diversions shall be designed, installed and maintained in accordance with Part 3 of this Section and Sections 6.21 and 8.05 of the NC ESCPDM. The cost of temporary and permanent diversions shall include the excavation, grading, materials, etc. and all maintenance and restoration activities required.

#### 2.07 TEMPORARY SLOPE DRAINS

- A. Temporary slope drains shall be constructed as shown on the Contract Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in Section 6.32 of the NC ESCPDM. Temporary slope drains are used to convey concentrated runoff down the face of a slope without causing erosion and are generally used in conjunction with temporary diversions.
- B. The pipe diameter for temporary slope drains shall be selected according to Table 6.32a of the NC ESCPDM. The pipe shall be heavy-duty flexible material such as non-perforated, corrugated plastic pipe or specially designed flexible tubing.
- C. Temporary slope drains shall be designed, installed and maintained in accordance with Part 3 of this Section and Section 6.32 of the NC ESCPDM, to the satisfaction of the Engineer, until the site has been stabilized. The cost of the temporary slope drains shall include the piping, earthwork, stone for erosion control, and all maintenance activities required.

#### 2.08 TEMPORARY GRAVEL CONSTRUCTION ENTRANCES/EXITS

- A. Temporary gravel construction entrances/exits shall be located at points where vehicles enter and leave a construction site, at other locations indicated by the Engineer, as specified herein, and as detailed in Section 6.06 of the NC ESCPDM.
- B. Temporary gravel construction entrances/exits shall be constructed with a minimum 6 inch layer of 2 – 3 inch washed stone placed over a stable foundation and shall be a minimum of 100 feet in length and 25 feet in width. Geotextile fabric shall be used under stone as shown on the Contract Drawings.

- C. Temporary gravel construction entrances/exits shall be designed, installed and maintained in accordance with Part 3 of this Section and Section 6.06 of the NC ESCPDM, to the satisfaction of the Engineer, until the site has been stabilized. The cost of temporary gravel construction entrances/exits shall include the materials and all maintenance activities required, including additional tire washing as may be necessary.

## 2.09 TEMPORARY AND PERMANENT STABILIZATION OF DISTURBED AREAS

- A. Temporary and permanent stabilization of disturbed areas will be provided at the locations shown on the Contract Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in Sections 6.10, 6.11, 6.12 and 6.14 of the NC ESCPDM. The Contractor shall provide ground cover adequate to restrain erosion on disturbed areas that will be left un-worked for periods exceeding 7 to 14 days, as noted in Section 1.01. F. of this specification.
- B. Soil amendments, including lime and fertilizer, shall be as detailed in Sections 6.10, 6.11 and 6.12 of the NC ESCPDM.
- C. Seed mixtures shall be selected based on site location and seasonal recommendations outlined in Sections 6.10 and 6.11 of the NC ESCPDM. Sod shall be selected based on site location and intended use as outlined in Section 6.12 of the NC ESCPDM.
- D. Mulch shall be as detailed in Section 6.14 of the NC ESCPDM. RECPs shall be as detailed in 2.05 herein and in Section 6.17 of the NC ESCPDM.
- E. Temporary soil stabilizer shall consist of an especially prepared highly concentrated powder which, when mixed with water, forms a thick liquid such as "Enviroseal 2001" by Enviroseal Corporation, "Terra Control" by Quattro Environmental, Inc., or "CHEM-CRETE ECO-110" by International CHEM-CRETE Corporation, and having no growth or germination inhibiting factors. The agent shall be used for hydroseeding grass seed in combination with other approved amendments resulting in a highly viscous slurry which, when sprayed directly on the soil, forms a gelatinous crust.
- F. Temporary and permanent stabilization of disturbed areas shall be achieved in accordance with Part 3 of this Section and Sections 6.10, 6.11, 6.12, 6.14 and 6.17 of the NC ESCPDM. The cost of temporary and permanent stabilization of disturbed areas shall include all grading, excavation and materials as well as all reseeding and other maintenance activities required until stabilization is achieved.

## 2.10 FIBER FILTRATION TUBES (FFTS) AND SEDIMENT LOGS

- A. FFTs and sediment logs shall be installed at the locations shown on the Contract Drawings, at other locations indicated by the Engineer, and as specified herein.
- B. FFTs shall consist of composite wood fibers and man-made fibers, with or without performance-enhancing polymers, encased with cylindrical tubes composed of a heavy-duty, knitted, high density polyethylene mesh. The photodegradable mesh shall be oriented in a diamond or hexagonal pattern and shall move freely at all knitted yarn intersections.

- C. Sediment logs shall consist of natural fibers (wood, coconut, etc.) inside heavy duty knitted cylindrical tubing.
- D. FFTs and sediment logs shall be designed, installed and maintained as specified herein. If Manufacturer's recommendations are more stringent, they shall supersede. The cost of FFTs shall include all excavation, grading and materials as well as all maintenance activities required.

#### 2.11 TEMPORARY AND PERMANENT CHANNELS

- A. Temporary and permanent channels shall be installed at the locations shown on the Contract Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in Sections 6.30, 6.31 and 8.05 of the NC ESCPDM. Temporary and permanent channels shall be used to convey concentrated runoff without damage from erosion, deposition or flooding.
- B. Temporary and permanent channels shall be designed, installed and maintained in accordance with Part 3 of this Section and Sections 6.30, 6.31 and 8.05 of the NC ESCPDM. The cost of all temporary and permanent channels shall include all excavation, grading and materials as well as all maintenance activities required.

#### 2.12 TREE PROTECTION FENCE

- A. Tree protection fence shall be installed at the locations shown on the Contract Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in Section 6.05 of the NC ESCPDM.
- B. Tree protection fence shall be used to protect trees and their root zones during construction. Tree protection fence shall be brightly-colored, UV-resistant poly barricade fabric. Signs designating the area as protected shall be installed on all sides of the fence. Wording and spacing of the signage shall be as indicated on the Contract Drawings.
- C. Tree protection fence shall be installed and maintained in accordance with Part 3 of this Section and Section 6.05 of the NC ESCPDM. The cost of tree protection fence shall include all materials as well as all maintenance activities required.

### PART 3 – EXECUTION

#### 3.01 INSTALLATION AND MAINTENANCE

- A. All installation and maintenance shall be conducted in accordance with this specification and the NC ESCPDM. In the event of a discrepancy between this specification, Manufacturer's recommendations and the NC ESCPDM, the more stringent requirements shall take precedence.
- B. If applicable, all requirements of the NPDES Permit shall be followed. In the event of a discrepancy between this specification and the NPDES Permit requirements, the more stringent requirements shall take precedence.

- C. If possible, erosion and sedimentation control devices shall be established prior to clearing operations in a given area. Where such practice is not feasible, the erosion and sedimentation control device(s) shall be established concurrent with the clearing operations or immediately following completion of the clearing operations.
- D. The Contractor shall furnish the labor, materials and equipment required for routine maintenance of all erosion and sedimentation control devices. At a minimum, maintenance shall be scheduled as required for a particular device to maintain the removal efficiency and intent of the device. Note that specific maintenance intervals for various measures and practices are specified within the NC ESCPDM. Of the maintenance requirements specified herein and in the NC ESCPDM, the more stringent shall take precedence for each and every sediment and erosion control measure utilized on the site. Maintenance shall include but not be limited to 1) the removal and satisfactory, legal disposal of accumulated sediment from traps or silt barriers and 2) replacement of filter fabrics used for silt fences and stone impaired by sediment in stone filters, gravel construction entrances, etc. Maintenance as noted in items 1) and 2) above shall be performed as required, and at least once every 3 months for the duration of construction activities. Sediment removed from erosion and sedimentation control devices shall be disposed of in locations that will not result in off-site sedimentation as acceptable to the Engineer, at no additional cost to the Owner. If no suitable on site locations are available, all such sediment will be legally disposed of off site, at no additional cost to the Owner.

### 3.02 SILT FENCE

- A. Silt Fence shall be designed, installed and maintained in accordance with the requirements of Section 6.62 of the NC ESCPDM. Silt fence shall be erected at the locations shown on the Contract Drawings and at all other locations as may be directed by the Engineer. Silt fence shall be erected and maintained to the satisfaction of the Engineer until a vegetative ground cover has been established. Replacement of the filter fabric and its associated appurtenances, if required by the Engineer, will be at the Contractor's expense.
- B. Silt fence shall not be installed across streams, ditches, waterways or other areas of concentrated flow.
- C. Dig a trench approximately 8 inches deep and 4 inches wide and place the fabric in the bottom of the excavated ditch or use the slicing method to insert the fabric into a cut sliced in the ground with a disc. Ensure that the height of the sediment fence does not exceed 24 inches above the ground surface.
- D. Install posts 4 feet apart in critical areas and 6 feet apart on standard applications when extra strength filter fabric is used. When wire mesh support is used, posts shall be installed a maximum of 8 feet apart. Install posts 2 feet deep on the downstream side of the silt fence, as close as possible to the fabric.
- E. Joints should be avoided along the fencing. When joints are necessary, securely fasten the filter cloth only at a support post with 4 feet minimum overlap to the next post.



- F. Compaction is vitally important for effective results. Compact the soil immediately next to the silt fence fabric with the front wheel of the tractor, skid steer or roller exerting at least 60 pounds per square inch. Compact the upstream side first and then each side twice for a total of 4 trips.
- G. Stabilized outlets for silt fence shall be provided at locations shown on the Contract Drawings. The outlet section shall have a maximum width of 4 feet. The height of silt fence at the outlet shall be a maximum of 1 foot. A 5 foot x 5 foot (minimum) apron of #57 washed stone shall be provided on the downstream side of the silt fence outlet.
- H. Silt fence shall be erected around all catch basins which are located downstream from any construction work unless other inlet protection is specified. Should any catch basins be indicated to be relocated or modified, silt fence shall be utilized until work is completed on the catch basins. Upon completion of the modification, the area shall be rough graded, as shown on the Contract Drawings, until the end of the project, at which time final grading shall occur.
- I. Inspect silt fence at least once a week and after each rainfall event. Make any required repairs immediately.
- J. Should the fabric of any silt fence collapse, tear, decompose or become ineffective, replace it promptly. All fabric shall be replaced after the first 3 months of construction activity and every 3 months thereafter until construction activities are complete.
- K. Remove sediment deposits as necessary to provide adequate storage volume for the next rain and to reduce pressure on the fence. Take care to avoid undermining the fence during cleanout.
- L. Remove all fencing materials and unstable sediment deposits and bring the area to grade and stabilize it after the contributing drainage area has been properly stabilized. Removal of any silt fence shall be permitted only with the prior approval of the Engineer or the local governing agency.

### 3.03 STONE FOR EROSION CONTROL

- A. Stone for erosion control shall be designed, installed, and maintained in accordance with the requirements of Section 6.15 of the ESCPDM. Stone for erosion control shall be dumped and placed in such manner that the larger rock fragments are uniformly distributed throughout the rock mass and the smaller fragments fill the voids between the larger fragments. Rearranging of individual stones by equipment or by hand shall only be required to the extent necessary to secure the results specified above, to protect structures from damage when rock material is placed against the structures, or to protect the underlying Separator Geotextile from damage during installation.
- B. Inspect at least weekly and within 24 hours after any storm event of greater than ½ inch of rain per 24-hour period. Remove accumulated sediment and replace stone impaired by sediment as necessary.

### 3.04 RIPRAP

- A. Riprap shall be designed, installed and maintained in accordance with the requirements of Section 6.15 of the NC ESCPDM. Riprap shall be graded so that the smaller stones are uniformly distributed through the mass. The Contractor may place the stone by mechanical methods, augmented by hand placing where necessary or ordered by the Engineer. The placed riprap shall form a properly graded, dense, neat layer of stone. The placed riprap shall have a minimum depth of 24 inches unless otherwise specified by the Engineer. Type II Separator Geotextile, as specified in Section 02274 – Geotextiles, shall be used under all riprap unless otherwise noted.
- B. Inspect periodically for scour or dislodged stones. Control of weed and brush growth may be needed.

### 3.05 ROLLED EROSION CONTROL PRODUCTS

- A. RECPs shall be designed, installed and maintained in accordance with the requirements of Section 6.17 of the NC ESCPDM. The Engineer may direct the Contractor to place RECPs in permanent channels or on slopes at other locations in addition to those shown on the Contract Drawings. If Manufacturer's instructions are more stringent, they shall supersede.
- B. The Contractor shall place the RECPs where directed immediately after the channel or slope has been properly graded and, if applicable, prepared, fertilized, and seeded.
- C. Grade the surface of the installation area so that the ground is smooth and loose. When seeding prior to installation, follow the steps in Section 6.10 (Temporary Seeding) and 6.11 (Permanent Seeding) of the NC ESCPDM as applicable. Remove all large rocks, debris, etc. so as to ensure that good contact between the RECP and the ground is maintained so that no erosion occurs beneath the RECP. Terminal anchor trenches are required at RECP ends and intermittent trenches must be constructed across channels at 25-foot intervals. Terminal anchor trenches should be a minimum of 12 inches in depth and 6 inches in width, while intermittent trenches should be a minimum of 6 inches deep and 6 inches wide. Take care to maintain direct contact between the soil and the RECP.
- D. For slope installation, place RECP 2-3 feet over top of slope and into an approximately 12 inch deep by 6 inch wide excavated end trench. Using staples, stakes, or pins, anchor the RECP at 1 foot intervals along the bottom of the trench, backfill, and compact. Along the slope, pin the RECP in a 3 foot center-to-center pattern; provide a minimum 3 inch overlap for adjacent rolls.
- E. For channel installations, excavate 12 inch deep by 6 inch wide terminal trenches across the upper and lower end of the lined channel. Anchor the RECP at a minimum of 25 foot intervals utilizing either two rows of anchors or 6 inch by 6 inch cross trenches. Bury outside RECP edges in longitudinal trenches 6 inches deep and wide along the channel edges. Pin the RECP in at 1 foot intervals along the bottom of terminal trenches, backfill, and compact. Overlap adjacent rolls a minimum of 3 inches and pin at 1 foot intervals. Place the first RECP at the downstream end of the channel and unroll

upstream. When starting installation of a new roll, begin in a trench or shingle-lap ends of rolls a minimum of 1 foot with upstream RECP on top to prevent uplifting.

- F. Staples, stakes, and pins shall be driven so that the top is flush with the ground.
- G. During the establishment period, check RECPs at least weekly and within 24 hours after any storm event of greater than ½ inch of rain per 24-hour period. Immediately make repairs. Good contact with the ground must be maintained. Monitor and repair the RECP as necessary until ground cover is established.

### 3.06 TEMPORARY AND PERMANENT DIVERSIONS

- A. Temporary diversions shall be designed, installed and maintained in accordance with the requirements of Sections 6.20 and 8.05 of the NC ESCPDM. Permanent diversions shall be designed, installed, and maintained in accordance with the requirements of Sections 6.21 and 8.05 of the NC ESCPDM. The Contractor shall provide temporary and permanent diversions at all locations noted on the Contract Drawings and at all other locations as may be directed by the Engineer.
- B. Remove and properly dispose of all trees, debris, etc. Fill and compact all ditches, swales, etc. that will be crossed to natural ground level or above.
- C. Excavate, shape and stabilize diversions as shown on the Contract Drawings and described herein. Unless otherwise noted, provide vegetative stabilization immediately after installation of permanent diversions. Temporary diversions that are to serve longer than 7 working days shall be seeded and mulched as soon as they are constructed to preserve dike height and reduce maintenance. Seed and mulch disturbed areas draining into the diversions within 14 calendar days of completing any phase of grading.
- D. For temporary diversions, ensure that the top of the dike is not lower at any point than the design elevation plus the specified settlement. Provide sufficient room around temporary diversions to permit machine re-grading and cleanout. Vegetate the ridge of temporary diversions immediately after construction unless they will remain in place less than 7 working days.
- E. Provide outlet protection adequate to accept flow from diversion plus any other contributing runoff. Sediment-laden runoff shall be routed through a sediment-trapping device.
- F. Inspect temporary diversions once a week and after every rainfall event. Immediately remove sediment from the flow area and repair the diversion ridge. Carefully check outlets and make timely repairs as needed. When the area protected is permanently stabilized, remove the ridge and the channel to blend with the natural ground level and appropriately stabilize it. Inspect permanent diversions weekly and after every rainfall event during construction operations until permanent vegetation is established. After vegetation is established, inspect after major storms. Immediately remove any debris and make repairs as needed in a timely manner. Maintain healthy vegetation at all times.

### 3.07 TEMPORARY SLOPE DRAINS

- A. Temporary slope drains shall be designed, installed and maintained in accordance with the requirements of Section 6.32 of the NC ESCPDM. The Contractor shall provide temporary slope drains with inlet and outlet protection and associated diversion channels at all locations noted on the Contract Drawings, and at other locations as may be directed by the Engineer.
- B. Place slope drains on undisturbed soil or well compacted fill. Slightly slope the section of pipe under the dike toward its outlet. Hand-tamp the soil under and around the entrance section in lifts not to exceed 6 inches.
- C. Ensure that all slope drain connections are watertight. Ensure that all fill material is well-compacted. Securely fasten the exposed section of the drain with grommets or stakes spaced no more than 10 feet apart. Extend the drain beyond the toe of the slope and provide outlet protection.
- D. Immediately stabilize all disturbed areas following construction.
- E. Inspect the temporary slope drain, inlet and outlet protection, and supporting diversions weekly and after every rainfall event and promptly make any necessary repairs. When the protected area has been permanently stabilized, temporary measures may be removed, materials disposed of properly, and all disturbed areas stabilized appropriately.

### 3.08 TEMPORARY GRAVEL CONSTRUCTION ENTRANCES/EXITS

- A. Temporary gravel construction entrances/exits shall be designed, installed and maintained in accordance with the requirements of Section 6.06 of the NC ESCPDM. The Contractor shall provide temporary gravel construction entrances/exits at all locations noted on the Contract Drawings and at all other locations as may be directed by the Engineer.
- B. Maintain the gravel pad as specified in Section 6.06 of the NC ESCPDM and in a condition to prevent mud or sediment from leaving the construction site. This may require periodic topdressing with 2 – 3 inch stone. Inspect each construction entrance at least weekly and after each rainfall event and replace stone impaired by sediment as necessary. Immediately remove all objectionable materials spilled, washed, or tracked onto public roadways.
- C. If, despite the use of a gravel construction entrance/exit, most of the mud and sediment are not removed from vehicle tires, tire washing may be necessary as detailed in Section 6.06 of the NC ESCPDM. If necessary this shall be done at no additional cost to the Owner.

### 3.09 TEMPORARY AND PERMANENT STABILIZATION OF DISTURBED AREAS

- A. The Contractor shall temporarily stabilize disturbed areas that will not be brought to final grade within 14 calendar days unless as noted in 1.01 F. of this Section. Temporary seeding shall be applied on areas that include diversions, dams, temporary sediment basins, temporary road banks and topsoil stockpiles. Areas to be stabilized with

permanent vegetation must be seeded or planted within 14 working days after final grade is reached, unless temporary stabilization is applied. Temporary seeding provides protection for no more than 1 year, after which permanent stabilization should be initiated.

- B. Complete grading before preparing seedbeds, and install all necessary erosion control measures. Minimize steep slopes. If soils become compacted during grading, loosen to a depth of 6-8 inches.
- C. Reseed and mulch temporary seeding areas where seedling emergence is poor, or where erosion occurs, as soon as possible. Do not mow. Protect from traffic as much as possible.
- D. Refer to Section 6.10 of the NC ESCPDM for additional information and specifications regarding seedbed requirements, plant selection, seeding and mulching for temporary seeding applications.
- E. The operation of equipment is restricted on slopes steeper than 3:1. Provisions for vegetation establishment can be made during final grading. Vegetation chosen for these sites must not require mowing or other intensive maintenance. Good mulching practices are critical for protecting against erosion on steep slopes.
- F. Generally, a stand of vegetation cannot be determined to be fully established until soil cover has been maintained for one full year from planting. Inspect seeded areas for failure and make necessary repairs and reseedings within the same season, if possible.
- G. Reseeding – If a stand has inadequate cover, re-evaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand after seedbed preparation or over-seed the stand. Consider seeding temporary, annual species if the time of year is not appropriate for permanent seeding.
- H. If vegetation fails to grow, soil must be tested to determine if acidity or nutrient imbalance is responsible.
- I. Fertilization - On the typical disturbed site, full establishment usually requires re-fertilization in the second growing season. Fine turf requires annual maintenance fertilization. Use soil tests if possible or follow the guidelines given for the specific seeding mixture.
- J. Refer to Section 6.11 of the NC ESCPDM for additional information and specifications regarding seedbed requirements, plant selection, seeding and mulching for permanent seeding applications.
- K. Refer to Section 6.12 of the NC ESCPDM for additional information and specifications regarding soil preparation, sod selection, installation, and maintenance for sodding.
- L. Inspect all seeded areas weekly and after heavy rains until permanent cover is established. Inspect within 6 weeks of planting to see if stands are adequate. Fertilize, reseed and mulch damaged and sparse areas immediately.

### 3.10 FIBER FILTRATION TUBES (FFTS) AND SEDIMENT LOGS

- A. FFTs and sediment logs shall be placed along slopes to function as slope breaks and to minimize sediment transport and in diversions/channels to serve as check dams. The Contractor shall provide FFTs and sediment logs at all locations noted on the Contract Drawings, and at all other locations as may be directed by the Engineer.
- B. FFTs and sediment logs shall be installed to maintain contact with the soil surface. Install prior to seeding. May be installed before or after installation of RECPs.
- C. Anchor the upstream/upslope side of the FFTs using wire staples or approved devices at 1-foot intervals. Drive wooden stakes through downstream/downslope side of the FFTs at 2-foot intervals. Take care not to compress the FFTs. Backfill and compact loose soil against the upstream/upslope side. Overlap adjacent FFT ends by a minimum of 1 foot.
- D. For channel installation, construct anchor trench 3 inches deep by FFT diameter and place loose soil against upstream side of FFT. For channel gradients of 2%, install trenches on 25-foot intervals. Decrease interval distance with steeper channel gradients or more highly erosive soils.
- E. Any sediment accumulation at the base of the FFT must be removed when it reaches one-third of the height of the tube. FFT may need to be removed if fully loaded with captured sediment for maximum product performance. FFTs are to be left in place or removed from the site as directed by the Engineer.
- F. Sediment logs do not require installation trenches. Wood stakes shall be placed at least every 2 feet along the length of the sediment log. Stakes shall only penetrate the netting around the log. They shall not be driven through the center of the log. Sediment logs are to be left in place or removed from the site as directed by the Engineer.
- G. The FFTs and sediment logs shall be inspected at least weekly and within 24 hours after any storm event of greater than ½ inch of rain per 24-hour period. Look for signs of flow undercutting the logs. Re-anchor and replace as necessary.

### 3.11 TEMPORARY AND PERMANENT CHANNELS

- A. Temporary and permanent channels shall be designed, installed and maintained in accordance with the requirements of Sections 6.30, 6.31 and 8.05 of the NC ESCPDM. The Contractor shall provide temporary and/or permanent channels at all locations noted on the Contract Drawings, and at all other locations as may be directed by the Engineer.
- B. Remove all trees, brush, stumps, etc. from the channel area and dispose of properly.
- C. Excavate the channel to the dimensions shown on the plans, over-excavating to allow for liner thickness. Remove and properly dispose of all excess soil so that surface water may enter the channel freely.
- D. Armor the channel as specified on the Contract Drawings. If the specified channel lining requires an establishment period, protect the channel with mulch or a temporary liner sufficient to withstand anticipated velocities during this period.

- E. During the establishment period, inspect channels weekly and after every rainfall. After lining has been fully established, inspect channels after any storm event of greater than ½ inch of rain per 24-hour period. Immediately make repairs.
- F. Perform all channel construction to keep erosion and water pollution to a minimum. Immediately upon completion of the channel, vegetate all disturbed areas or otherwise protect them against soil erosion. Where channel construction will take longer than 7 days, stabilize channels by reaches.
- G. Inspect the channel outlet and all road crossings for bank stability and evidence of piping or scour holes. Give special attention to outlets and points where concentrated flow enters the channel.
- H. Maintain all vegetation adjacent to and in the channel in a healthy, vigorous condition to protect the area from erosion.
- I. Remove all significant sediment accumulations to maintain the designed carrying capacity.

### 3.12 OUTLET STABILIZATION STRUCTURE

- A. Outlet stabilization structures shall be designed, installed and maintained in accordance with the requirements of Sections 6.41 and 8.06 of the NC ESCPDM.
- B. The Contractor shall ensure the subgrade, riprap and gravel filter conforms to the grading limits shown on the plans.
- C. Riprap shall be installed in accordance with the specifications contained herein, with filter fabric placed under the riprap.
- D. The apron shall be constructed on zero grade with no overfill. Ensure the apron is properly aligned with the receiving stream.
- E. All disturbed areas shall be stabilized with vegetation immediately after construction.
- F. Outlet stabilization structures shall be inspected at least weekly and within 24 hours after any storm event of greater than ½ inch of rain per 24-hour period to see if any erosion around or below the riprap has taken place or if stones have been dislodged. Repairs shall be made immediately.

### 3.13 TREE PROTECTION FENCE

- A. Tree protection fence shall be installed and maintained in accordance with the requirements of Section 6.05 of the NC ESCPDM. If Manufacturer's recommendations are more stringent, they shall supersede.
- B. Install tree protection fence around all designated tree protection areas prior to clearing, deliveries, and other construction activities onsite. Post signs designating area as protected on all sides of the fencing.

- C. Inspect tree protection fence weekly. Repair and replace as needed.

### 3.14 ADDITIONAL REQUIREMENTS

- A. All storm sewer piping shall be blocked at the end of every working day until the inlet is constructed above grade.
- B. All streets around the construction area shall be scraped as necessary to prevent accumulation of dirt and debris.
- C. The Contractor shall provide adequate means to prevent any sediment from entering any storm drains, curb inlets (curb inlet filter box), ditches, streams, or bodies of water downstream of any area disturbed by construction. Excavation materials shall be placed upstream of any trench or other excavation to prevent sedimentation of offsite areas. Silt fence will be provided, at no additional cost to the Owner, around excavation materials if deemed necessary by the Engineer. In areas where a natural buffer area exists between the work area and the closest stream or water course, this area shall not be disturbed.
- D. The Engineer may direct the Contractor to place any additional sediment and erosion control devices at other locations not shown on the Drawings.

### 3.15 INSPECTIONS AND MAINTENANCE

- A. The Contractor shall designate an Authorized Representative to perform inspections and maintenance as described herein. Contractor shall perform regular inspections and maintain records as follows:
  - 1. Inspections shall be performed, at a minimum, once every seven calendar days and within 24 hours after any storm event of greater than ½ inch of rain per 24 hour period.
  - 2. A rain gauge shall be maintained in good working order on the site and all rainfall amounts recorded throughout the duration of construction activities.
  - 3. Inspection reports must be available on-site during business hours unless a site-specific exemption is approved.
  - 4. Inspection records must be kept for 3 years following completion of construction and be available upon request.
  - 5. Electronically-available records may be substituted under certain conditions as approved by Land Quality and DWQ.
- B. During inspections the following will be observed and appropriate maintenance activities shall be performed:
  - 1. The conformance to specifications and current condition of all erosion and sediment control structures.



2. The effectiveness and operational success of all erosion and sediment control measures.
  3. The presence of sediments or other pollutants in storm water runoff at all runoff discharge points.
  4. The presence of sediments or other pollutants in receiving waters.
  5. Evidence of off-site tracking at all locations where vehicles enter or exit the site.
  6. Evidence of impacts to water quality due to site activities pertaining to equipment operation and maintenance, material handling, and material storage and construction laydown areas exposed to precipitation.
- C. Immediate action shall be taken to repair/maintain erosion and sediment control measures that are not performing as designed. The State reserves the right to stop all construction activities not related to these measures until such deficiencies are repaired.
- D. In areas that have undergone final stabilization, inspections and, if necessary, maintenance by Contractor will occur at least once per month for the duration of the contract or project, whichever is longer.

### 3.16 MONITORING AND REPORTING

- A. Monitoring: The Contractor shall be responsible for the implementation of the Inspections and Maintenance Procedures as included in the approved erosion and sediment control plan. The implementation must comply with guidelines as set forth in the NPDES General Permit NCG 010000 (Part I Section B: Minimum Monitoring and Reporting Requirements), as well as those of any local regulatory authorities. Minimum monitoring requirements are as follows:
1. A rain gauge shall be maintained in good working order on the site.
  2. A written record of the daily rainfall amounts shall be retained. (Note: if no rainfall occurred the Contractor must record "zero").
  3. The control measures shall be inspected to ensure that they are operating correctly. Inspection records must be maintained for each inspection event and for each measure. All erosion and sedimentation control measures must be inspected by the Contractor at least once every seven calendar days and within 24 hours after any storm event of greater than ½ inch of rain per 24 hour period unless otherwise noted herein. Some measures require inspection following each rainfall event.
  4. Once land disturbance has begun on the site, stormwater runoff discharge outfalls shall be inspected by observation for erosion, sedimentation and other stormwater discharge characteristics such as clarity, floating solids, and oil sheens. Inspections of the outfalls shall be made at least once every seven calendar days and within 24 hours after any storm event of greater than ½ inch of rain per 24 hour period. Inspection records must be maintained for each inspection event and for each discharge location.

5. If any visible sedimentation is leaving the site or entering waters of the State, corrective action shall be taken immediately to control the discharge of sediments. Where visible deposition of sediment has occurred in surface waters or wetlands, the Contractor must verbally contact the Engineer and the Division of Water Quality within 24 hours of becoming aware of the deposition. Written notification shall be made to the Engineer and the Division of Water Quality within 5 days of becoming aware of the deposition.
- B. Reporting: The Contractor must keep a record of inspections onsite with a copy of the approved erosion and sediment control plan. Inspection records shall be made available to DWQ or its authorized agent upon request. Copies of inspection records shall be sent to the Engineer on a monthly basis. The records must provide the details of each inspection including observations and corrective actions taken as described below. The required rainfall and monitoring observations shall be recorded on an "Inspection Record for Activities Under Stormwater General Permit NCG010000" form provided by DWQ or a similar inspection form that is inclusive of all of the elements contained in the Division's form. A sample inspection form can be found at the end of this Section.
1. Control Measure Inspections: Inspection records must include at a minimum: 1) identification of the measures inspected, 2) date and time of the inspection, 3) name of the person performing the inspection, 4) indication of whether the measures were operating properly, 5) description of maintenance needs for the measure, 6) corrective actions taken and 7) date of actions taken.
  2. Stormwater Discharge Inspections: Inspection records must include at a minimum: 1) identification of the discharge outfall inspected, 2) date and time of the inspection, 3) name of the person performing the inspection, 4) evidence of indicators of stormwater pollution such as oil sheen, floating or suspended solids or discoloration, 5) indication of visible sediment leaving the site, 6) actions taken to correct/prevent sedimentation and 7) date of actions taken.
  3. Visible Sedimentation Found Outside the Site Limits: Inspection records must include 1) an explanation as to the actions taken to control future releases, 2) actions taken to clean up or stabilize the sediment that has left the site limits and 3) the date of actions taken.
  4. Visible Sedimentation Found in Streams or Wetlands: All inspections should include evaluation of streams or wetlands onsite or offsite (where accessible) to determine if visible sedimentation has occurred.
  5. Visible Stream Turbidity – If the discharge from a site results in visible stream turbidity, inspection records must record that evidence and actions taken to reduce sediment contributions.
- C. The State reserves the right to use its own resources to duplicate monitoring and verify the work required by the Contractor in this section.
1. The Sedimentation Pollution Control Act requires persons responsible for land-disturbing activities to inspect a project after each phase of the project to make sure that the approved erosion and sedimentation control plan is being followed.

2. The self-inspection program is separate from the weekly self-monitoring program of the NPDES Stormwater Permit for Construction Activities. The focus of the self-inspection report is the installation and maintenance of erosion and sedimentation control measures according to the approved plan. The inspections should be conducted after each phase of the project, and continued until permanent ground cover is established.
  3. The Self-Inspection Report form may be found at the end of this section and is also available as an Excel spreadsheet from the Land Quality web site, [http://www.dlr.enr.state.nc.us/pages/sedimentation\\_new.html](http://www.dlr.enr.state.nc.us/pages/sedimentation_new.html)
- D. Sites discharging to streams named on the state's 303(d) list as impaired for sediment-related causes may be required to perform additional monitoring, inspections or application of more stringent management practices if it is determined that the additional requirements are needed to assure compliance with the federal or state impaired-waters conditions. Inspection records must be maintained for each inspection event and for each discharge location. If a discharge covered by this permit enters a stream segment that is listed on the Impaired Stream List for sediment-related causes, and a Total Maximum Daily Load (TMDL) has been prepared for those pollutants, the Permittee must implement measures to ensure that the discharge of pollutants from the site is consistent with the assumptions and meets the requirements of the approved TMDL. The DWQ 303(d) list can be found at: [http://h2o.enr.state.nc.us/tmdl/General\\_303d.htm/](http://h2o.enr.state.nc.us/tmdl/General_303d.htm/).

### 3.17 REMOVAL OF TEMPORARY SEDIMENT CONTROL STRUCTURES

- A. At such time that temporary erosion and sediment control structures are no longer required under this item, the Contractor shall notify the Engineer of its intent and schedule for the removal of the temporary structures. The Contractor shall obtain the Engineer's approval in writing prior to removal. Once the Contractor has received such written approval from the Engineer, the Contractor shall remove, as approved, the temporary structures and all sediments accumulated at the removed structure shall be returned upgrate and stabilized so they do not re-erode. In areas where temporary control structures are removed, the site shall be left in a condition that will restore original drainage. Such areas shall be evenly graded and seeded as specified in Section 02910 - Final Grading and Landscaping.

-- - END OF SECTION - --

(The Inspection Record for Activities under Stormwater General Permit NCG01000 and the Land Quality Self-Inspection Report Form follows this Section.)



# INSPECTION RECORD

## FOR ACTIVITIES UNDER STORMWATER GENERAL PERMIT NCG010000

PROJECT: \_\_\_\_\_ MONITORING FOR THE WEEK BEGINNING: \_\_\_\_\_

All erosion and sedimentation control measures and stormwater discharge outfalls must be inspected at least once per seven calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period. Permittee must keep a record of inspections onsite and send copies of inspection reports to the Engineer monthly. Inspection records must be maintained for each inspection event and for each discharge location.

RAINFALL: Gauge must be maintained on site. Record amount daily.

Day/Date	Rainfall Amount (inches)	Name Of Inspector

By this signature, I certify (in accordance with Part II Section B (10) of the NCG010000 permit) that this report is accurate and complete to the best of my knowledge:

(Signature of Permittee or Designee)
Date

CONTROL MEASURE INSPECTION: May require additional pages.

Measure Identification (i.e., silt fence, sediment pond, sediment trap, ground cover)	Date and time of inspection	Name of inspector	Operating properly? (Y/N)	Describe maintenance needs/corrective actions taken (may need to attach additional information)	Date corrective action taken

STORMWATER DISCHARGE OUTFALL INSPECTION: May require additional pages.

Stormwater Discharge Outfall Identification	Date and time of inspection	Name of inspector	Evidence of other pollutants discharging from the site (i.e., oil sheen, discoloration, cement wastes, sanitary waste, fertilizers, or fuel or material storage leakage)	Erosion seen near outfall? (Y/N)	Describe actions taken to correct/prevent sedimentation	Date corrective action taken

Visible sedimentation found outside site limits? (Y/N) If Yes, was DWQ contacted?	Describe actions taken to control future releases and actions taken to clean up or stabilize the sediment that has left the site	Visible sedimentation found in streams, wetlands, or buffers? (Y/N)	Describe actions taken to control future releases and actions taken to clean up or stabilize the sediment that has left the site	Date corrective action taken	Visible decrease in stream clarity (increased turbidity/cloudiness)? (Y/N)	Describe actions taken to reduce sediment contributions	Date corrective action taken

VISIBLE SEDIMENTATION AND/OR STREAM TURBIDITY: Any visible sedimentation observed during inspections must be recorded, corrected, and cleaned up. Take immediate corrective action to control the discharge of sediments outside the disturbed limits of the site.

Has all land disturbing activity been completed? \_\_\_\_\_ (Y/N) Has the final permanent ground cover been completed & established? \_\_\_\_\_ (Y/N)

SELF-INSPECTION REPORT FOR LAND DISTURBING ACTIVITY AS REQUIRED BY NCGS 113A-54.1

PROJECT NAME:		PROJECT NO.:	
NAME OF INSPECTOR:		AFFILIATION*:	
(*Landowner, Financially Responsible Party or Agent)			
ADDRESS OF INSPECTOR:			
TELEPHONE NUMBER:			
Signature:			Date:
(Landowner, Financially Responsible Party or Agent)			

Phase of Approved Erosion and Sedimentation Control Plan:		Mark (X)
Installation of perimeter erosion and sediment control measures		
Clearing and grubbing of existing ground cover		
Completion of any phase of grading of slopes or fills		
Installation of storm drainage facilities		
Completion of construction or development		
Establishment of permanent ground cover sufficient to restrain erosion		

EROSION AND SEDIMENTATION CONTROL MEASURES INSPECTED:

Name/Number/ Location of Measure (List all measures on Plan)	Measures Installed Since Last Report		Measure Operating Properly (Yes/No)	Significant Deviation from Plan? (Yes/No)	Describe Corrective Actions Needed *
	Proposed Dimensions (feet)	Actual Dimensions (feet)			

SECTION 02500  
SURFACE RESTORATION

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Provide all labor, equipment, and materials necessary for final grading, topsoil placement, and miscellaneous site work not included under other Sections but required to complete the work as shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 - Earthwork
- B. Section 02276 - Erosion and Sedimentation Control
- C. Section 02910 - Final Grading and Landscaping

PART 2 – MATERIALS

2.01 TOPSOIL

- A. Topsoil shall meet the requirements of Section 02200 – Earthwork.

PART 3 – EXECUTION

3.01 FINAL GRADING

- A. Following approval of rough grading the subgrade shall be prepared as follows:
  - 1. For riprap, bare soil 24 inches below finish grade or as directed by Engineer.
  - 2. For topsoil, scarify 2-inches deep at 4 inches below finish grade.

3.02 TOPSOIL PLACEMENT

- A. Topsoil shall be placed over all areas disturbed during construction under any contract except those areas which will be paved, graveled or rip rapped.
- B. Topsoil shall be spread in place for lawn and road shoulder seed areas at a 4-inch consolidated depth and at a sufficient quantity for plant beds and backfill for shrubs and trees.
- C. Topsoil shall not be placed in a frozen or muddy condition.
- D. Final surface shall be hand or mechanically raked to an even finished surface to finish grade as shown on Drawings.

- E. All stones and roots over 4-inches and rubbish and other deleterious materials shall be removed and disposed of.

- - END OF SECTION - -



SECTION 02604  
UTILITY STRUCTURES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, equipment, and tools required for the design, fabrication, delivery and installment of utility structures and appurtenances in accordance with the Drawings and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 – Earthwork
- B. Section 03200 – Reinforcing Steel
- C. Section 03250 – Concrete Accessories
- D. Section 03300 – Cast-in-Place Concrete
- E. Section 03400 – Precast Concrete
- F. Section 05540 – Castings

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
  - 1. ASTM C478–Specification for Precast Reinforced Concrete Manhole Sections
  - 2. ASTM C857–Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
  - 3. ASTM C990–Specifications for Joints in Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

1.04 SUBMITTALS

- A. Submit samples and/or Shop Drawings in accordance with Section 01300, Submittals.
- B. In addition to items listed in Section 03400, Precast Concrete, Shop Drawings shall include, but not be limited to:
  - 1. Complete layout and installation Drawings and schedules with clearly marked dimensions.

2. Material certificates on all piping materials.
3. Structural design calculations sealed by a P.E. registered in the State of North Carolina. Design calculations for precast manholes and vaults shall include confirmation structures adequately resist flotation when they are totally empty and subjected to groundwater full height of structure.
4. Results of leakage test

## PART 2 – PRODUCTS

### 2.01 PRECAST MANHOLES, VAULTS, AND METER BOXES

- A. Precast utility structures shall be furnished with waterstops, sleeves and openings as noted on the Drawings. Box out for wall pipes shall conform accurately to the sizes and elevations of the adjoining pipes. Precast utility structures shall be watertight and conform to the requirements of ASTM C 478 and ASTM C857 with the following modifications there to:
  1. Materials shall conform to Section 03400, Precast Concrete.
  2. Manholes shall meet the following:
    - a. Manhole section shall have an internal diameter of 4'-0", unless noted otherwise.
    - b. Minimum manhole wall thicknesses shall be 5 inches for 4 foot and 5 foot diameter manholes, 6 inches for 6 foot diameter manholes and 7 inches for 7 foot diameter manholes.
    - c. Manholes and utility structures shall include ballast concrete and/or other means necessary to insure manholes resist flotation when empty and subjected to groundwater full height of structure.
    - d. Precast manholes and utility structures shall be as manufactured by NC Products/Oldcastle, Tindall Products, or equal.
  3. The date and name of manufacturer shall be marked inside each precast section.
  4. No more than two lift holes may be cast or drilled in each section.
  5. Dimensions shall be as shown on the Drawings.
  6. Covers and frames shall be as specified in Section 2.13.
  7. Mechanical Details such as piping, electrical, and other details shall be as shown on the Drawings.
- B. Joints between manhole and utility structures riser sections and at base slabs shall be groove type.

### 2.02 CONCRETE

- A. Concrete shall conform to Section 03300, Cast-in-Place Concrete.

### 2.03 REINFORCING

- A. Reinforcing shall conform to Section 03200, Reinforcing Steel.

### 2.04 PRECAST CONCRETE

- A. Precast concrete shall conform to Section 03400, Precast Concrete.

### 2.05 CASTINGS

- A. Castings shall conform to Section 05540, Castings. Casting shall be of the type and size indicated on the Drawings.

### 2.06 STEPS

- A. Steps shall be constructed of Grade 60 steel reinforcing rod (min. 1/2-inch) and completely encapsulated with a wear resistant and chemical resistant rubber.
- B. Each step shall have a minimum vertical load resistance of 800 pounds and a minimum pull-out resistance of 400 pounds.
- C. The steps shall have 11-inch minimum tread width and shall be placed at 16-inches on center, as shown on the Drawings.
- D. Steps shall be cast in place with the concrete.
- E. Steps shall only be installed as shown on the Drawings or required in the Specifications.

### 2.07 JOINT SEALANT

- A. Joint sealant shall be a preformed flexible sealant conforming to the requirements of ASTM C990, paragraph 6.2, Butyl Rubber Sealant. Joint sealant shall be Pro-Stik Butyl Sealant by Press-Seal, Butyl-Nek Join Sealant by Henry, CS-102 Butyl Rubber Sealant for all Precast Structures by ConSeal, or equal.

### 2.08 FLEXIBLE RUBBER SLEEVE

- A. The spring set type shall have a stainless steel interior power sleeve or expander and shall be the PSX assembly by Press-Seal Gasket Corporation, the Kor-N-Seal assembly by National Pollution Control Systems, or Lock Joint Flexible Manhole Sleeve by Interpace Corp.
- B. The cast-in-place type shall conform to ASTM C923 and shall include stainless steel take up clamps.
- C. Flexible seal assemblies shall permit at least an eight (8) degree deflection from the center line of the opening in any direction while maintaining a watertight connection.

### 2.09 RUBBER BLADDER

- A. The rubber bladder seal shall conform to ASTM C923 suitable for pressure testing at 10 psi minimum, with a 3/8 inch minimum wall thickness.

- B. The rubber bladder seal shall contain an environmentally safe, anti-bacterial compound which turns into a high viscosity gel when in contact with pressurized water.
- C. The rubber bladder seal shall be NPC Contour Seal by Kor-N-Seal, or equal.

## 2.10 COVERS AND FRAMES

- A. Covers and frames shall comply with Section 05540, Castings and shall be provided by the utility structure manufacturer.
- B. Manhole covers and frames shall meet the following requirements:
  - 1. Locate so that there is ready access to the manhole steps
  - 2. Clear opening shall be a minimum of 22 inches, unless otherwise indicated on the Drawings.
  - 3. Watertight manhole frames and covers shall be suitable for 20 psi internal pressure and shall be Neenah Model R-1915, Type P or L or equal cast in place.
  - 4. Non-watertight manhole covers shall be perforated and shall be Neenah Model R-1668, or equal.
  - 5. Storm drain grated inlet frames and grates shall be Neenah R-1878-B7G, East Jordan Iron Works V5660, or equal.
  - 6. Curb inlet frames and grates shall be Neenah R-3067, East Jordan Iron Works EJ 7030, or equal, and shall include frame, grate, and hood.
- C. Vault covers shall have lifting handles and shall be bolted with stainless steel bolts complying with Section 05050, Metal Fastening.
- D. All frames and covers shall be given one shop coat of asphalt or coal tar varnish, unless otherwise specified.
- E. Frames and covers shall be identical throughout the Contract.

## 2.11 GRATES

- A. Grates shall comply with Section 05540, Castings.

## 2.12 CONCRETE BALLAST

- A. Concrete ballast shall be Class B concrete in conformance with Section 03300, Cast-in-Place Concrete. Ballast shall be provided as necessary to insure manhole resists flotation when empty and subjected to full height groundwater conditions.

## 2.13 FLEXIBLE JOINT SEALER

- A. Flexible joint sealer shall be a rubber ring waterstop as manufactured by Fernco Joint Sealer Co., or equal.

## 2.14 EPOXY BONDING AGENT

- A. Epoxy bonding agent shall conform to Section 03250, Concrete Accessories.

## PART 3 – EXECUTION

### 3.01 DESIGN CRITERIA

- A. Minimum structural design loading for underground precast concrete vaults shall be as indicated in ASTM C857, unless otherwise noted herein. Precast items subjected to vehicular traffic shall be designed for H-20 traffic loading. Other precast items shall be designed for a vertical live load of 300 psf.
- B. Walls of precast items shall be designed for a vertical surcharge of 100 psf.
- C. Precast manholes and vaults shall be designed to resist flotation when totally empty and subjected to groundwater full height of the manhole/vault.

### 3.02 FABRICATION AND CASTING

- A. Fabrication and casting shall conform to Section 03400, Precast Concrete, and to Section 03300, Cast-in-Place Concrete.
- B. All base sections designated to receive concrete ballast and all electrical manholes shall extend monolithically a minimum of 6 inches beyond the outside face of the wall for the entire periphery. All other utility structures shall have a standard base.
- C. Utility structures built around existing pipe shall have a cast-in-place base slab.

### 3.03 HANDLING, TRANSPORTING, AND STORING

- A. Handling, transporting and storing of precast items shall comply with Section 03400, Precast Concrete.

### 3.04 INSTALLATION

- A. Installation shall conform with Section 03400, Precast Concrete and with the manufacturer's recommendations or to Section 03300, Cast-in-Place Concrete.
- B. Frames and covers or grates shall be set so that tops are at elevations indicated on the Drawings or flush with finished grade where no elevation is indicated.
- C. Joints between riser sections shall be sealed with joint sealant.
- D. All openings in utility structures shall have flexible rubber sleeves sized to fit the connecting pipe and installed to provide watertight joints in accordance with the manufacturer's recommendations. The interior of the sleeve shall be filled with Class B concrete.
- E. Openings that are too large for flexible rubber sleeves shall utilize rubber bladder seals which are expanded by water injected using a pressure pump.
- F. All units shall be installed plumb and level.

- G. All lift holes and joints shall be filled with non-shrink grout conforming to Section 03600, grout inside and out.
- H. The manhole frames shall be set to their required elevations either with grade rings or with two or three courses of brick masonry laid around the top of the upper wall section. Such brick work shall be given a 1-inch mortar coat on the inside and out.
- I. Concrete ballast shall be placed so that it bears directly on the utility structure base against the outer wall monolithically encircling the structure for the full height indicated on the Drawings. Additional ballast may be required where the depth or elevation of the structure varies from the Drawings.
- J. Brick or concrete block shall be laid with broken joints and all horizontal and vertical joints filled with cement-sand mortar. Outside of walls shall be plastered with a minimum 1-inch thick coat of cement-sand mortar troweled smooth.
- K. Connection to Existing Pipe
  - 1. Verify the diameter and invert elevation of existing pipe to be connected to new utility structures prior to beginning work on the structures.
  - 2. Provide adequate protection to prevent damage to the existing pipe.
  - 3. Provide adequate means for plugging and/or transferring the existing flow in the pipe to allow for the construction of inverts and grouting.
  - 4. Cut off the existing pipe sufficiently for connection to the new structure and remove.
  - 5. Thoroughly clean all foreign matter and coat the pipe surface with epoxy adhesive where the pipe joins the new structure.
  - 6. Install a flexible joint sealer around the pipe.
  - 7. Grout inside and outside of wall penetration with nonshrink grout.
- L. Backfill structures in accordance with Section 02200, Earthwork.
- M. Clean all structures of any accumulation of silt, debris, or foreign matter and keep clean until final acceptance of the work.
- N. Excavation shall conform to Section 02200, Earthwork.
- O. Structure bases shall bear on a minimum of 8 inches of compacted stone unless otherwise indicated on the Drawings.
- P. Channel Inverts
  - 1. Inverts shall be placed using Class B concrete with forms sufficient to provide a smooth half-round shape as shown on the Drawings. Manhole bases employing full depth precast inverts are acceptable.
  - 2. Where the slope of the line does not change through a manhole, a constant slope shall be maintained in the invert. Where slope changes occur within a given manhole, the transition shall be smooth and shall occur at the approximate center of the manhole.

3. Inverts shown on the Drawings are taken at the center of the manhole unless otherwise noted.

### 3.05 ADJUSTMENTS TO EXISTING UTILITY STRUCTURES

- A. Adjust structures as indicated on the Drawings using concrete or cast iron adjustment rings by approved methods.
- B. Clean covers and inlet castings of all foreign material and paint with one coat of coal tar epoxy.

### 3.06 ADJUSTING COLLARS AND FINAL ADJUSTMENTS

- A. Adjusting collars shall be as shown on the Drawings. Final adjustments shall be made so that the manhole ring and cover will be smooth and flush with the finished grade of the adjacent surface, or as otherwise indicated on the Drawings for manholes shown above grade.

### 3.07 FLUSHING AND TESTING

- A. Obstruction - After backfilling, all sewers shall be inspected for obstructions and shall be flushed with water. Flushing shall be a minimum velocity of 2.5 feet per second for a duration acceptable to the Engineer. Flushing shall remove all dirt, stones, pieces of wood and other debris which accumulated in the sewer during construction. The Contractor shall provide a means acceptable to the Engineer for removal of debris flushed from each section of sewer. If after flushing, any obstructions remain, they shall be removed at the Contractor's expense.
- B. Visual Inspection - Sewer lines shall be visually inspected from every manhole by use of mirrors, television cameras, or other devices for visual inspection, and the lines shall all exhibit a fully circular pattern when viewed from one manhole to the next. Lines which do not exhibit a true line and grade or have structural defects shall be corrected to meet these qualifications.
- C. Leakage - Sewers shall be tested for leakage. The program of testing shall fit the conditions as mutually determined by the Engineer and the Contractor. The Contractor shall take all necessary precautions to prevent any joints from drawing while the sewers or their appurtenances are being tested. The Contractor shall, at his own expense, correct any excess leakage and repair any damage to the pipe and their appurtenances, or to any structures resulting from or caused by these tests.
- D. Leakage Test Procedure
  1. Each section of sewer shall be tested by closing the lower end of the sewer to be tested and the inlet sewer of the upper manhole with stoppers and filling the pipe and manhole with water to a point 6 feet above the crown of the open sewer in the upper manhole, or, if ground water is present, 6 feet above the sections average adjacent ground water level as indicated by a monitor well installed adjacent to each manhole. The line shall be filled with water prior to testing and allowed to stand until the pipe has reached its maximum absorption, but not less than two (2) hours. After maximum absorption has been reached, the head shall be reestablished and tested for at least six (6) hours maintaining the head specified above by measured additions of water. The sum of these additions shall be the leakage for the test period.

2. If ground water is present to a height of at least 6 feet above the crown of the sewer at the upper end of the pipe section to be tested, the leakage test may be made by measuring the rate of infiltration using a suitable weir or other measuring device approved by the Engineer.
  3. Whether the test is made by infiltration or exfiltration, the allowable leakage shall not exceed 100 gallons per day per inch of diameter per mile of sewer being tested. Where the actual leakage exceeds the allowable, the Contractor shall discover the cause and correct it before the sewer will be accepted. For the purpose of this subsection, a section of sewer is defined as that length of sewer between successive manholes or special structures or stubouts for future connections.
- E. Low Pressure Compressed Air Test If the leakage cannot be located by infiltration or exfiltration testing, this type test may be used. The pipeline shall be considered acceptable, when tested at an average pressure of 3.0 psi greater than the average back pressure of any groundwater that may submerge the pipe, if the section under test does not lose air at a rate greater than 0.0030 cfm per sq. ft. of internal pipe surface.
- F. Deflection Test No sooner than thirty (30) days after final backfill installation, each section of PVC pipe shall be checked for vertical deflection using an electronic deflecto meter or a rigid "Go No Go" device. Vertical deflection shall not exceed five (5) percent of the inside pipe diameter for PVC pipe. Where the actual deflection exceeds the allowable, the Contractor shall discover the cause and correct it before the pipe will be acceptable. For the purpose of this subsection, a section of sewer is defined as that length of sewer between successive manholes or special structures or stubouts for future connections.
- G. Cost of Testing and Repairs Any and all work necessary to bring the line into conformance with the infiltration and deflection specifications shall be performed by the Contractor at no extra cost to the Owner. All apparent sources of infiltration and excessive deflection shall be repaired by the Contractor. The Contractor shall provide all water, plugs, hoses, pumps, equipment, etc. necessary for the proper flushing and testing of the sewers.

- - END OF SECTION - -



## SECTION 02831

### STEEL FENCING

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install steel fencing, posts, gates, etc., where shown on the Drawings and in compliance with these Specifications.
- B. Fencing shall be of the chain link type topped with barbed wire. The 6 foot high fabric shall clear the final grade by 3 inches, and shall be topped with three strands of barbed wire. The barbed wire shall be angled outward at the top. All components which are to be galvanized shall be hot dipped galvanized, coating to be 1.8 ounces per square foot of surface. Alternate coatings which employ a zinc coating of less than 1.8 ounces per square foot are not acceptable.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300 - Cast-in-Place Concrete.

##### 1.03 SUBMITTALS

- A. Shop Drawings shall be furnished in accordance with Section 01300, Submittals.

#### PART 2 – PRODUCTS

##### 2.01 CHAIN LINK FABRIC

- A. Fabric shall be 9 gauge aluminum coated wire woven in a 2 inch diamond mesh conforming to ASTM A491. Top and bottom selvage to have a barbed finish. Minimum weight of coating shall be 0.40 ounce per square foot of wire surface. The coated wire shall have a minimum tensile strength of 80,000 lbs. per square inch.
- B. Install fabric 3 inches above ground level. Fence shall be stretched tight and securely fastened to posts at points spaced 12 inches apart maximum.

##### 2.02 POSTS

- A. Posts and rails shall be galvanized standard weight pipe conforming to the requirements of ASTM F1083.
  - 1. Line Posts: Line posts shall be Schedule 40, 2 3/8 inch O.D. galvanized pipe with minimum bending strength of 201 pounds under a 6 foot cantilever load. Line posts shall be spaced at a maximum 10-foot O.C.

2. Terminal Posts: All end, corner, intermediate, and pull posts and gate leaves 6'0" wide and less shall be 2 7/8 inch O.D. galvanized Schedule 40 pipe with minimum bending strength of 381 pounds on 6 foot cantilever load. Gate posts for gate leaves shall be Schedule 40 pipe complying with ASTM F1083 of diameters as follows:

<u>Gate Leaf Width</u>	<u>Pipe O.D.</u>	<u>Weight per Ft.</u>
0' to 6'	2-7/8"	5.79 lbs.
Over 6' to 13'	4"	9.1 lbs.
Over 13' to 18'	6-5/8"	18.97 lbs.
Over 18'	8-5/8"	24.7lbs.

#### 2.03 TENSION WIRE

- A. Top and bottom tension wire shall be No. 7 gauge aluminum coated steel wire. Fabric shall be securely tied to tension wire at intervals not to exceed 24 inches.

#### 2.04 POST TOPS AND BARBED WIRE SUPPORTS

- A. Gate, end, corner and line post tops shall be malleable iron or pressed steel and shall be hot dipped galvanized conforming to ASTM A153.
- B. Extension arms for supporting the three (3) strands of barbed wire for line posts shall be of pressed steel with malleable iron base, or solid aluminum alloy castings.
- C. Angles for line post extension arms shall be approximately 45 degrees from the vertical and the top slot for barbed wire shall be a minimum of 12 inches above the fabric and a minimum of 10 inches from the fence line.

#### 2.05 BARBED WIRE

- A. Barbed wire shall consist of three strands of 12 1/2 gauge aluminum coated steel wire with 4 point barbs of 14 gauge aluminum wire spaced 5 inches apart, conforming to ASTM A585.
- B. Additional strands of barbed wire shall be added beneath the chain link fabric at all ditch crossings to maintain the security of the fence installation.

#### 2.06 BRACES AND TOP RAILS

- A. Braces and top rails (where shown on the Drawings) shall be 1.66 inch O.D., Schedule 40 galvanized pipe with minimum vertical bending strength of 202 pounds on 10 foot span.
- B. Top rails shall be continuous and shall pass through the post tops. The coupling used to join the top rail lengths shall allow for expansion. Brace rails shall be provided at all terminal posts, located between the top and grade lines and extend from the terminal post to the first adjacent post. Braces shall be securely fastened at both ends. Brace ends for receiving brace rails shall be malleable iron or castings of 356.0 (formerly SG70A) alloy, or equivalent of ASTM B26 or B108.

- C. Truss and stretcher bands shall be 1/8 inch x 7/8 inch pressed steel, supplied with carriage bolts and nuts. Bolts shall be 5/16 inch by 1 1/4 inch. Truss rods shall be 3/8 inch nominal diameter.

## 2.07 FABRIC TIES

- A. Wire ties shall be preformed 0.148 inch diameter (9 gauge) aluminum. Flat band type ties shall be 1100 H18 or 3003 H14, .064 inch thick by 1/2 inch wide.
- B. Hog rings for attaching tension wire to fabric shall be 0.105 inch diameter, Alloy 1100 H14.

## 2.08 GATES

- A. Gate frames shall be made of 2 inch O.D. ASTM F1083 pipe, 2.72 lbs. per foot hot dipped galvanized. Fabric shall match fence. Gate frames shall be welded or assembled with riveted corner castings. Gate frames shall be equipped with 3/8 inch diameter adjustable truss bars. Hinges shall be ball and socket.
- B. Gate shall be equipped with positive latching device with provision for padlocking. Personnel gates shall be minimum 36 inch clear opening.

# PART 3 – EXECUTION

## 3.01 INSTALLATION

- A. All line posts shall be spaced equidistant in the fence line on a maximum of 10 foot centers. Posts shall be set plumb in concrete bases as detailed on Drawings. The top of the posts shall be brought to a smooth grade line. The wire fence shall be set accurately to line and grade and shall be plumb.
- B. End, corner, pull or intermediate posts shall be placed in the following locations: corners; changes in direction; abrupt changes in grade; intervals no greater than 500 feet in the fence line. Each end or gate post shall have one brace assembly and each corner or intermediate post shall have two brace assemblies.
- C. Horizontal braces shall be provided at all terminal posts, corner posts, and intermediate posts between top rail and ground and shall extend from the above mentioned posts to the first adjacent line posts. Braces shall be securely fastened to the line posts by brace ends and brace bands and to the terminal posts by approved rail end connectors. Diagonal brace rods shall be trussed from the brace end on the line post back to the terminal post, corner post or intermediate post and fastened to it by an approved connector.

## 3.02 POST FOUNDATIONS

- A. Post holes shall be in true alignment and of sufficient size to provide a permanent foundation of concrete. Holes shall be well centered on the posts. A minimum diameter of 12 inches shall be required for all posts.
- B. Post foundations shall be carefully rodded or tamped into place. The top of concrete shall extend 2 inches above ground line and shall be neatly troweled and leveled up from edges to the posts so as to have a pitch outward in all directions.

- C. No materials shall be installed on the posts, nor shall any load be applied to the posts within 3 days after the individual post foundation is completed.
- D. All concrete shall be Class "B" in conformance with Section 03300, Cast-in-Place Concrete.

### 3.03 RESETTING OF EXISTING FENCE

- A. Where shown on the Drawings that resetting of existing fence is required, the fence, after resetting, shall be in a condition that is equal to or better than before the fence was removed.
- B. The Contractor shall replace any of the fence components which have been unnecessarily damaged by him.

### 3.04 PADLOCK AND KEYS

- A. One solid brass padlock shall be furnished with each gate. Padlocks shall be master keyed to the system specified under Section 08710, Finish Hardware.

### 3.05 TEMPORARY FENCING

- A. The Contractor shall furnish and install all temporary fencing and appurtenances as shown on the Drawings or as required during construction to adequately secure the site prior to installation of the permanent fence.

- - END OF SECTION - -

SECTION 02910  
FINAL GRADING AND LANDSCAPING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all labor, equipment, and materials necessary for final grading, topsoiling, seeding, and miscellaneous site work not included under other Sections, but required to complete the work as shown on the Drawings and specified herein. Under this Section, all areas of the project site disturbed by excavation, materials storage, temporary roads, etc., shall be reseeded as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02276 - Erosion and Sedimentation Control.
- B. Section 02500 - Surface Restoration.

1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
  - 1. Product Data
  - 2. Certification of all materials
  - 3. Three (3) copies of composition and germination certification and of test results for grass seed.

PART 2 – PRODUCTS

2.01 CONTRACTOR'S RESPONSIBILITIES

- A. Furnish and submit certification for the materials used as specified in the General Conditions, Division 1 and Division 2.

2.02 TOPSOIL

- A. Upon completion and approval of the rough grading, the Contractor shall place the topsoil over all areas disturbed during construction under any contract except those areas which will be paved, graveled or rip rapped. Topsoil shall not be placed in a frozen or muddy condition and shall contain no toxic materials harmful to grass growth. Topsoil shall be as defined under Section 02200, Earthwork.

## 2.03 WATER

- A. Water shall be furnished to the Contractor by the Owner from existing facilities as directed by the Engineer.
- B. The Contractor shall furnish all hoses and connections necessary to complete the landscaping work.

## 2.04 FERTILIZER

- A. Fertilizer shall be a complete commercial fertilizer with components derived from commercial sources. Fertilizer analysis shall be determined from field soil sampling in appropriate number taken by the Contractor and analyzed by the N.C. Department of Agriculture or other independent laboratory. Contractor shall furnish fertilizer in accordance with the recommendations of the N.C. Department of Agriculture.
- B. One quarter of the Nitrogen shall be in the form of nitrates, one quarter in the form of ammonia salts, and one half in the form of natural organic Nitrogen. Available Phosphoric Acid shall be free from superphosphate, bone, or tankage. Potash shall be Sulphate of Potash. Elements shall conform to the standards of Association of Official Agricultural Chemists.
- C. Fertilizer shall be delivered in standard size bags marked with the weight, analysis of contents, and the name of the manufacturer. Fertilizer shall be stored in weatherproof storage areas and in such a manner that its effectiveness will not be impaired.

## 2.05 LIME

- A. At least 50% shall pass a No. 200 U.S.S. mesh sieve. At least 90% shall pass a No. 100 U.S.S. mesh sieve and 100% shall pass a No. 10 U.S.S. mesh sieve. Total carbonates shall not be less than 80% or 44.8% Calcium Oxide equivalent. For the purpose of calculation, total carbonates shall be considered as Calcium Carbonate.

## 2.06 GRASS SEED

- A. The Contractor shall furnish the kinds and amounts of seed to be seeded in all areas disturbed by the construction work. All seed shall be labeled to show that it meets the requirements of the North Carolina Seed Law. All seed must have been tested within six (6) months immediately preceding the planting of such material on the job.
- B. The inoculant for treating legume seed shall be a pure culture of nitrogen fixing bacteria prepared specifically for the species. Inoculants shall not be used later than the date indicated on the container. The quality of the seed shall conform to the following:

Type	Minimum Seed Purity (%)	Minimum Germination (%)	Maximum Weed Seed (%)
Fescue (fungus free)	98	90	1.00
Hybrid Rye	98	85	0.10
Sudan grass	98	85	0.25

Millet	98	85	0.50
Sericea Lespedeza			
Scarified	98	85	0.50
Unscarified	98	85	0.50

- C. Scarified Lespedeza may contain 20% hard seed and unscarified 50% hard seed. Seed containing prohibited noxious weed seed shall not be accepted. Seed shall be in conformance with N.C. Seed Law restrictions for restricted noxious weeds.
- D. Seed mixtures to be used on the project shall be as follows:
- P - 150#/acre Kentucky 31 Tall Fescue  
(Add 25#/acre Sudan grass in May. Add 25#/acre hybrid rye during Nov.)
  - TW - 120#/acre Hybrid Rye and 50#/acre Annual Lespedeza
  - TS - 40#/acre Pearl or Brown Top Millet or 50#/acre Sudan grass
- Note: P - Permanent Seeding  
TW - Temporary Winter Seeding  
TS - Temporary Summer Seeding
- E. On cut and fill slopes 2:1 or steeper add 30#/acre of Sericea Lespedeza to the P seed mixture. Sericea Lespedeza seed shall be scarified for spring plantings and unscarified for fall plantings.

## 2.07 WOOD CELLULOSE FIBER MULCH

- A. For use in hydroseeding grass seed in combination with fertilizers and other approved additions, shall consist of especially prepared wood cellulose fibers such as "Conwed", "Mat Fiber", or equal, and have no growth or germination inhibiting factors, and be dyed green.
- B. The wood cellulose fiber shall have the additional characteristic of dispersing rapidly in water to form a homogeneous slurry and remain in such state when agitated in the hydraulic mulching unit, or adequate equal, with the specified materials.
- C. When applied, the wood cellulose fiber with additives will form an absorptive mat but not a plant inhibiting membrane, which will allow moisture, natural or mechanical, to percolate into underlying soil.
- D. The mulch shall be supplied, compressed in packages containing 50 pounds of material having an equilibrium air dry moisture content at time of manufacture of 12% plus or minus 3%. Wood cellulose fiber mulch shall be stored in a weatherproof storage area and in such a manner that effectiveness will not be impaired.

## 2.08 STRAW MULCH

- A. Straw used for mulch shall be small grain hay. Hay shall be undamaged, air dry, threshed straw, free of undesirable weed seed. Straw mulch is not required for seeded areas treated with a temporary soil stabilizer.

## 2.09 TEMPORARY SOIL STABILIZER

- A. The temporary agent for soil erosion control shall consist of an especially prepared highly concentrated powder which, when mixed with water, forms a thick liquid such as "Enviroseal 2001" by Enviroseal Corporation, "Terra Control" by Quattro Environmental, Inc., or "CHEM-CRETE ECO-110" by International CHEM-CRETE Corporation, and having no growth or germination inhibiting factors. The agent shall be used for hydroseeding grass seed in combination with other approved amendments resulting in a highly viscous slurry which, when sprayed directly on the soil, forms a gelatinous crust.

## 2.10 ROLLED EROSION CONTROL PRODUCTS

- A. The rolled erosion control products (RECPs) shall be as specified in Section 02276 - Erosion and Sedimentation Control.

## 2.11 RIPRAP AND HERBICIDES

- A. Furnish and install sufficient quantity of landscape gravel or riprap to cover over the ground to a minimum 4 inch depth for gravel and 24 inch depth for riprap, unless otherwise noted, or indicated on the Drawings. Also furnish and apply an approved herbicide to the subgrade surface just prior to installing the landscape gravel or riprap.
- B. During placing, the stone shall be graded so that the smaller stones are uniformly distributed through the mass. The Contractor may place the stone by mechanical methods, augmented by hand placing where necessary or ordered by the Engineer. The placed riprap shall form a properly graded, dense, neat layer of stone.
- C. All topsoil and vegetative matter shall be removed from the subgrade surfaces prior to the application of the weed killer (herbicide) and to the placement of landscape gravel or riprap. Apply commercial type herbicide as preemergence control of miscellaneous grasses and broadleaf weeds in granular or liquid form such as "Treflan", "Dymid", or equal. Methods and rates of application shall be in strict compliance to manufacturer's directions and acceptable to the Engineer.
- D. The herbicide selected shall be safe for use around ornamental plantings, have long lasting weed control, and shall be resistant to leaching away under excessive rainfall.
- E. A second application of the herbicide shall be made on the surface of the landscape gravel or riprap sometime after the first six (6) months, but not later than 12 months. Same methods and rates apply as specified previously.

## PART 3 – EXECUTION

### 3.01 GRADING

- A. After approval of the rough grading, the Contractor shall commence his preparations of the subgrade for the various major conditions of the work as follows:
  - 1. Bare soil for riprap area at subgrade (24 inches below final grade, or as directed by the Engineer).



2. Topsoil for lawn and road shoulder seed area scarify 2 inch depth of subgrade (4 inches below final grade) prior to placing topsoil.

B. Final surface grading of the topsoiled, landscape graveled, and riprapped areas shall be mechanically raked or hand raked to an even finished surface alignment.

### 3.02 TOPSOIL

A. Topsoil shall be spread in place for quantity required for lawn and road shoulder seed areas at 4 inch consolidated depth, and sufficient quantity for certain plant beds and backfill for shrubs and trees as specified.

### 3.03 SEEDBED PREPARATION

A. Contractor shall prepare all areas to receive temporary or permanent seeding measures prior to planting.

B. Topsoil shall be placed in areas to be seeded and roughened with tracked equipment or other suitable measures. Slopes steeper than 3:1 may be roughened by grooving, furrowing, tracking, or stairstep grading. Slopes flatter than 3:1 should be grooved by disking, harrowing, raking, operating planting equipment on the contour.

C. Soil amendments including, but not limited to, lime and fertilizer shall be spread as necessary, and at the rates specified in this Section. Seeding shall be as per the type and rates specified in this Section. Seed shall be broadcast as soon as possible following roughening, before surface has been sealed by rainfall.

### 3.04 HYDROSEEDING AND GRASS

A. The Contractor shall grow a stand of grass by hydroseeding method on all disturbed areas. The Contractor shall be responsible for the satisfactory growth of grass throughout the period of the one year guarantee.

B. The Contractor's work shall include the preparation of the topsoil and bare soil seed bed, application of fertilizer, limestone, mulching, inoculant, temporary soil stabilizer, watering, and all other operations necessary to provide a satisfactory growth of sod at the end of the one year maintenance period. Areas without satisfactory sod at the end of one (1) year shall be replanted until satisfactory growth is obtained and acceptable to the Engineer.

C. All areas to be seeded shall be done by the hydraulic seeding method including all additives and amendments required. A "Reinco", "Finn", or "Bowie" type hydromulcher with adjustable nozzles and extension hoses, or equal, shall be utilized. General capacity of tank should range from 500 to 2,500 gallons, or as approved by the Engineer.

D. Hydraulic seeding shall be carried out in three steps. Step one shall consist of the application of lime. In step two the seed mixture shall be mixed with the fertilizer, wood cellulose fiber mulch, and any required inoculants and applied to the seed bed. Step three shall consist of application of top dressing during the first spring or fall, whichever comes first, after step two.

- E. Top dressing shall consist of a commercial grade fertilizer plus Nitrogen or other analysis as may be recommended by soil testing. Types and application rates of seed mixtures, lime, fertilizer, and wood cellulose fiber mulch, shall be as shown in the Seeding Schedule.
- F. Ingredients for the mixture and steps should be dumped into a tank of water and thoroughly mixed to a homogeneous slurry and sprayed out under a minimum of 300 350 pounds pressure, in suitable proportions to accommodate the type and capacity of the hydraulic machine to be used. Applications shall be evenly sprayed over the ground surface. The Contractor shall free the topsoil of stones, roots, rubbish, and other deleterious materials and dispose of same off the site. The bare soil, except existing steep embankment area, shall be rough raked to remove stones, roots, and rubbish over 4 inches in size, and other deleterious materials and dispose of same off the site.
- G. No seeding should be undertaken in windy or unfavorable weather, when the ground is too wet to rake easily, when it is in a frozen condition, or too dry. Any bare spots shown in two to three weeks shall be recultivated, fertilized at half the rate, raked, seeded, and mulched again by mechanical or hand broadcast method acceptable to the Engineer.
- H. Areas that have been seeded with a temporary seed mixture shall be mowed to a height of less than 2 inches and scarified prior to seeding with the permanent seed mixture.
- I. The Contractor shall provide, at his own expense, protection for all seeded areas against trespassing and damage at all times until acceptance of the work. Slopes shall be protected from damage due to erosion, settlement, and other causes and shall be repaired promptly at the Contractor's expense.
- J. The Contractor shall water newly seeded areas of the lawn and road shoulder mix once a week until the grasses have germinated sufficiently to produce a healthy turf, or unless otherwise directed by the Engineer. Each watering shall provide three (3) gallons per square yard. The Contractor shall furnish all necessary hoses, sprinklers, and connections.
- K. The first and second cutting of the lawn grasses only shall be done by the Contractor. All subsequent cuttings will be done by the Owner's forces in a manner specified by the Contractor.

### 3.05 DITCH AND SWALE EROSION PROTECTION

- A. All ditches and swales indicated on the Drawings shall be lined with a rolled erosion control product (RECP). The area to be covered shall be properly graded and hydroseeded before the RECP is installed. Installation shall be in accordance with Section 02276, Erosion and Sedimentation Control.

### 3.06 MAINTENANCE

- A. The Contractor shall be responsible for maintaining all seeded areas through the end of his warranty period. Maintenance shall include but not be limited to, annual fertilization, mowing, repair of seeded areas, irrigation, and weed control. The Contractor shall provide, at his own expense, protection for all seeded areas against trespassing and damage at all times until acceptance of the work. Slopes shall be protected from damage due to erosion, settlement, and other causes and shall be repaired promptly at the Contractor's expense.

- B. Annual fertilization shall consist of an application of 500#/acre of 10 10 10 commercial grade fertilizer, or its equivalent and 60#/acre of nitrogen in early fall, or other analysis as may be determined by soil test. Annual fertilization shall be in addition to top dressing and shall be performed by the Contractor each fall season after planting until the work is substantially complete.
- C. Mowing shall be scheduled so as to maintain a minimum stand height of 4 inches or as directed by the Engineer. Stand height shall be allowed to reach 8 to 10 inches prior to mowing.
- D. All seeded areas shall be inspected on a regular basis and any necessary repairs or reseeding made within the planting season, if possible. If the stand should be over 60% damaged, it shall be re established following the original seeding recommendations.
- E. Weed growth shall be maintained mechanically and/or with herbicides. When chemicals are used, the Contractor shall follow the current North Carolina Agricultural Experiment Stations' weed control recommendations and adhere strictly to the instructions on the label of the herbicide. No herbicide shall be used without prior approval of the Engineer.

### 3.07 CLEANUP

- A. The Contractor shall remove from the site all subsoil excavated from his work and all other debris including, but not limited to, branches, paper, and rubbish in all landscape areas, and remove temporary barricades as the work proceeds.
- B. All areas shall be kept in a neat, orderly condition at all times. Prior to final acceptance, the Contractor shall clean up the entire landscaped area to the satisfaction of the Engineer.

### 3.08 SEEDING SCHEDULE

- A. All seeding and mulching to be completed by the Contractor shall conform to the following schedule. No permanent seeding shall be performed from May 1 August 31 and November 1 February 14. Temporary seed mixtures will be used during these times if seeding is necessary. Areas seeded with temporary seed mixtures shall be reseeded by the Contractor at no additional cost to the Owner with permanent seed as directed by the Engineer.
- B. Application rates of seed mixtures, lime, fertilizer, mulch and top dressing are shown in the schedule.

# SEEDING SCHEDULE

Application Rates (Pounds/Acre)

Seed Mixture	Planting Season	Lime <sup>a</sup>	Seed	Fertilizer	Straw <sup>b</sup> Mulch	Topdressing <sup>a</sup>	Annual Fertilizer	Comments
P	Feb. 15-April 30 Sept. 1-Oct. 31	4000	150	1000	4000	500 of 10-10-10 60 of Nitrogen	Same as Topdressing	Preferred planting seasons are Sept. 1 – Sept. 30 and Feb. 15 – March 30.
TW	Jan. 1-May 1	2000	170	750	4000	-	-	Over seed with Type P seed mixture during next planting season.
TS	May 1-Aug. 15	2000	40	750	4000	-	-	Over seed with Type P seed mixture during next planting season.
TF	Aug. 15-Dec. 30	2000	120	1000	4000	-	-	Over seed with Type P seed mixture during next planting season.

## Footnotes:

- Application rates and/or chemical analysis shall be confirmed or established by soil test.
- On cut and fill slopes 2:1 or steeper, add 30#/acre Sericea Lespedeza to Type P seed mixture. Use scarified seed for spring plantings and unscarified for fall plantings.
- Apply asphalt at rate of 0.10 gallon per square yard (10 gal/1000 ft<sup>2</sup>) to tack straw mulch.

- - END OF SECTION - -

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MACDONALD DOWNS  
PUMP STATION

SECTION 02960  
TRAFFIC CONTROL

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall be responsible for the development of the traffic control plan and obtaining all required approvals.

1.02 STREET SIGNS AND MARKERS AND ROUTE MARKERS

- A. The Contractor shall move any existing street signs and markers and route markers out of the construction limits of the project and install the street signs and markers and route markers so that they will be visible to the traveling public if there is sufficient right of way for these signs and markers outside of the construction limits.
- B. Near the completion of the project and when so directed by the Engineer, the Contractor shall move the signs and markers and install them in their proper location in regard to the finished pavement of the project.
- C. Any signs or markers which cannot be relocated due to lack of right-of-way, or any signs and markers which will no longer be applicable after the construction of the project, shall be stockpiled at locations directed by the Engineer for removal by others.
- D. The Contractor will be responsible to the Owner for any damage to any street signs and markers or route markers during the above described operations.
- E. No direct payment will be made for relocating, reinstalling, and/or stockpiling the street signs and markers and route markers as such work will be considered incidental.

PART 2 – MATERIALS

2.01 CONSTRUCTION TRAFFIC CONTROL DEVICES

- A. Description - The work covered by this Section consists of furnishing, erecting, maintaining, relocating, and removing traffic control devices in accordance with the Drawings, Specifications, MUTCD, or as directed by the Engineer. The MUTCD referred to in this provision shall be the current edition of the Manual on Uniform Traffic Control Devices for Streets and Highways, as prepared by the National Advisory Committee on Uniform Traffic Control Devices, including all standard documents referred to in the second paragraph of Section 1A-7 of the MUTCD. The current edition shall be the edition current on the date of advertisement for the Project. All traffic control devices furnished by the Contractor shall remain the property of the Contractor, unless otherwise required by the Contract. Traffic control devices shall include, but not be limited to signs, non-metallic drums, barricades, cones, delineators, temporary guardrail, temporary pavement marking, raised reflective pavement markers, flaggers and pilot vehicles, as required.

- B. Materials - General - Unless otherwise required, materials used in the fabrication and installation of construction traffic control devices shall be in accordance with the applicable provision of the MUTCD. When traffic control devices are no longer required for traffic handling in the initial phase of construction requiring their use, they may be reused at various locations throughout the project provided the device is not defaced, is structurally sound, clean, and otherwise conforms to the above requirements.
- C. Traffic control devices which do not meet the requirements of this Section shall not be used; and, when during the life of a project, a device ceases to meet the requirements of this Section it shall be promptly removed and replaced with a conforming device at no additional compensation. The Engineer shall have the authority to determine the acceptability of the traffic control devices.
- D. Construction Methods - General - Traffic control devices shall be installed at the inception of construction operations, and shall be properly maintained, relocated as necessary, cleaned, and operated during the time they are in use. They shall remain in place only as long as they are needed and shall be immediately removed thereafter. Where operations are performed in stages, only those devices that apply to the conditions present shall be left in place.
- E. The location, legends, sheeting, dimensions, number of supports, and horizontal and vertical placement of warning signs, barricades, and other traffic control devices shall be as required by the Drawings or the MUTCD or as directed by the Engineer. The Contractor may submit for the Engineer's consideration a method for handling traffic other than as shown on the Drawings. The alternate traffic handling plans shall not be used until they are approved by the Engineer in writing. During periods when not warranted, warning signs and other devices shall be removed from the work area, covered with specified material, or otherwise positioned so they do not convey their message to the traveling public. If covered, the covering material shall be exterior plywood and shall cover the entire face of the sign panel. The covering material shall be installed in such a manner that the sign panel will not be defaced. Covering material shall be maintained in a neat and workmanlike manner during its use.
- F. Weeds, brush, trees, construction materials, equipment, etc., shall not be allowed to obscure any traffic control device in use.
- G. If cones are used for delineation at night, each cone shall have any appropriate white reflectorized cone collar as detailed on the Drawings, or as directed by the Engineer.
- H. Competent and properly trained flaggers, properly attired and equipped, shall be provided as shown on the Drawings, when directed by the Engineer, or when the Contractor deems it necessary to safely handle traffic through the construction area.
- I. The Contractor shall assume full responsibility for the continuous and expeditious maintenance of all construction warning signs, barricades, and other traffic control devices. Maintenance shall include repair and replacement of traffic control devices which, in the opinion of the Engineer, are damaged by traffic or other means, or deteriorated beyond effectiveness. Conditions covered under maintenance shall include but not be limited to replacement due to loss of reflectivity; replacement of broken supports; plumbing of leaning signs; cleaning of dirty signs, barricades, and other devices; repair of defaced sheeting and legend; and replacement of stolen or vandalized items. All items used for traffic control shall be maintained in a satisfactory condition. Failure to maintain all traffic control devices in a satisfactory condition may be cause for suspension of construction operations until proper traffic control is re-established.

- J. The Contractor shall continuously review and maintain all traffic handling measures to assure that adequate provisions have been made for the safety of the public and workers.

## 2.02 STATIONARY CONSTRUCTION SIGNS

- A. Description - The work covered by this Section consists of furnishing, erecting, relocating, maintaining, and removing stationary signs necessary for controlling traffic.
- B. Materials - Reflective sheeting shall be used on all sign facing and shall meet the requirements of AASHTO M268. The reflective sheeting shall be enclosed lens (Engineers grade) sheeting and shall have a smooth, sealed outer surface which will display the same color both day and night. The reflective sheeting on each sign shall have a smooth appearance. The reflective sheeting shall be applied in a workmanlike manner so that there are no bubbles or wrinkles in the material.
  - 1. The Contractor shall furnish a material certification in accordance with Article 106-3 of the NCDOT Standard Specifications for all new and used reflective sheeting as required by the Engineer.
- C. Construction Methods - All work shall be in accordance with requirements of Section 2.01.

## 2.03 TYPE III BARRICADES

- A. Description - The work covered by this Section consists of furnishing, erecting, maintaining, and removing Type III Barricades.
- B. Construction Methods - All work shall be in accordance with requirements of Section 2.01.

## 2.04 PORTABLE TEMPORARY TRAFFIC CONTROL DEVICES

- A. Description - The work covered by this Section consists of furnishing erecting, relocating, maintaining, and removing portable temporary traffic control devices necessary for controlling traffic. Portable temporary traffic control devices shall include but not be limited to portable signs, non-metallic drums, barricades, cones, delineators, flaggers, pilot vehicles, and any other traffic control device not covered by any other Sections included in this Contract.
- B. Portable Signs - Reflective sheeting shall be used on all sign facing and shall meet the requirement of AASHTO M268. The reflective sheeting shall be enclosed lens (Engineers grade) sheeting and shall have a smooth, sealed outer surface which will display the same color both day and night. The reflective sheeting on each sign shall have a smooth appearance. The reflective sheeting shall be applied in a workmanlike manner so that there are no bubbles or wrinkles in the material.
  - 1. The Contractor shall furnish a material certification in accordance with Article 106-3 of the NCDOT Standard Specifications for all new and used reflective sheeting as required by the Engineer.
- C. Non-Metallic Drums - The drums shall be made of plastic impact resistant material. The drums shall have a two-piece, breakaway design that will maintain its integrity upon impact throughout a temperature range of -20°F to 125°F. Upon impact the upper portion of the drum shall deform and breakaway from the base, minimizing damage to drums or vehicles. The base and ballast shall remain in position and vehicle shall easily pass over it.

1. The drums shall be designed to have two TYPE "A" or "C" light wells located on the top surface of the drums. The drums shall be designed with a top to completely seal the drums to prevent water from accumulating and freezing in the bottom of the drums. The base shall be designed to accommodate a sandbag of 40 lbs. to 60 lbs. A sandbag with 50 lbs. of sand shall be supplied with each drum.
  2. The drums shall have an assembled minimum height of 36", a minimum outside base diameter of 21", and a combined minimum weight of 12 lbs.
  3. The Contractor shall be required to furnish the Engineer a sample drum and its specifications for approval prior to the delivery of drums of the project.
  4. The markings on drums shall be horizontal, circumferential, orange and white stripes six to eight inches wide, covering entire outside. The entire area of orange and white shall be reflectorized with the enclosed lens (Engineers grade) sheeting, except for the corrugation area where a 2" non-reflectorized band will be allowed. There shall be at least two orange and two white stripes on each drum. Reflectorized material shall have a smooth, sealed outer surface which will display the same approximate color day and night. The reflective sheeting shall meet the requirement os AASHTO M268.
- D. Construction Methods - All work shall be in accordance with the requirements of Section 2.01.

#### 2.05 FLASHING ARROW PANELS

- A. Description - The work covered by this Section consists of furnishing, maintaining, moving, and relocating flashing arrow panels mounted on a trailer, truck, or other mobile unit, as shown on the Contract Drawings.
- B. Materials - The flashing arrow panels shall meet the requirements of the MUTCD (Section 6E) for a Type A panel.
- C. Construction Methods - All work shall be in accordance with the requirements of Section 2.01.
- D. During periods of times that traffic is shifted from its normal pattern, a mobile flashing arrow panel shall be used at locations shown on the Drawings or at locations directed by the Engineer.

#### PART 3 – EXECUTION NOT USED

- - END OF SECTION - -



SECTION 03200  
REINFORCING STEEL

PART 1 – GENERAL

1.01 THE REQUIREMENTS

- A. Provide all concrete reinforcing including all cutting, bending, fastening and any special work necessary to hold the reinforcing steel in place and protect it from injury and corrosion in accordance with the requirements of this section.
- B. Provide deformed reinforcing bars to be grouted into reinforced concrete masonry walls.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03250 - Concrete Accessories
- B. Section 03300 - Cast-in-Place Concrete
- C. Section 03400 - Precast Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
  - 1. North Carolina Building Code
  - 2. CRSI-Concrete Reinforcing Institute Manual of Standard Practice
  - 3. ACI SP66-ACI Detailing Manual
  - 4. ACI 315-Details and Detailing of Concrete Reinforcing
  - 5. ACI 318-Building Code Requirements for Structural Concrete
  - 6. WRI-Manual of Standard Practice for Welded Wire Fabric
  - 7. ASTM A 615-Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcing
  - 8. ASTM A 1064-Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.

1. Detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66), shall be furnished for all concrete reinforcing. These drawings shall be made to such a scale as to clearly show joint locations, openings, and the arrangement, spacing and splicing of the bars.
2. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.
3. Proposed supports for each type of reinforcing.

#### 1.05 QUALITY ASSURANCE

- A. If requested by the Engineer, the Contractor shall provide samples from each load of reinforcing steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the Owner. Costs of additional tests due to material failing initial tests shall be paid by the Contractor.

### PART 2 – PRODUCTS

#### 2.01 REINFORCING STEEL

- A. Bar reinforcing shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel reinforcing. All reinforcing steel shall be from domestic mills and shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on Drawings.
- B. Welded wire fabric reinforcing shall conform to the requirements of ASTM A 1064 and the details shown on the Drawings.
- C. A certified copy of the mill test on each load of reinforcing steel delivered showing physical and chemical analysis shall be provided, prior to shipment. The Engineer reserves the right to require the Contractor to obtain separate test results from an independent testing laboratory in the event of any questionable steel. When such tests are necessary because of failure to comply with this Specification, such as improper identification, the cost of such tests shall be borne by the Contractor.
- D. Field welding of reinforcing steel will not be allowed.
- E. Use of coiled reinforcing steel will not be allowed.

#### 2.02 ACCESSORIES

- A. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers and other devices to position reinforcing during concrete placement. Slab bolsters shall have gray plastic-coated legs.
- B. Concrete blocks (dobies), used to support and position bottom reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located.

## PART 3 – EXECUTION

### 3.01 TEMPERATURE REINFORCING

- A. Unless otherwise shown on the Drawings or in the absence of the concrete reinforcing being shown, the minimum cross sectional area of horizontal and vertical concrete reinforcing in walls shall be 0.0033 times the gross concrete area and the minimum cross sectional area of reinforcing perpendicular to the principal reinforcing in slabs shall be 0.0020 times the gross concrete area. Temperature reinforcing shall not be spaced further apart than five times the slab or wall thickness, nor more than 18 inches.

### 3.02 FABRICATION

- A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.
- B. The Contractor shall fabricate reinforcing bars for structures in accordance with the bending diagrams, placing lists and placing Drawings.
- C. No fabrication shall commence until approval of Shop Drawings has been obtained. All reinforcing bars shall be shop fabricated unless approved to be bent in the field. Reinforcing bars shall not be straightened or rebent in a manner that will injure the material. Heating of bars will not be permitted.
- D. Welded wire fabric with longitudinal wire of W9.5 size or smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches. Welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only.

### 3.03 DELIVERY, STORAGE AND HANDLING

- A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.
- B. Reinforcing steel shall be stored above ground on platforms or other supports and shall be protected from the weather at all times by suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate identification.
- C. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- D. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and if necessary recleaned.

### 3.04 PLACING

- A. Reinforcing steel shall be accurately positioned as shown on the Drawings and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground,

supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the reinforcing bars without settlement. In no case shall concrete block supports be continuous.

- B. The portions of all accessories in contact with the formwork shall be made of plastic or steel coated with a 1/8 inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.
- C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- D. Reinforcing bars additional to those shown on the Drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcing in position, shall be provided by the Contractor at no additional cost to the Owner.
- E. Reinforcing placing, spacing, and protection tolerances shall be within the limits specified in ACI 318 except where in conflict with the Building Code, unless otherwise specified.
- F. Reinforcing bars may be moved within one bar diameter as necessary to avoid interference with other concrete reinforcing, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed placing tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.
- G. Welded wire fabric shall be supported on slab bolsters spaced not less than 30 inches on centers, extending continuously across the entire width of the reinforcing mat and supporting the reinforcing mat in the plane shown on the Drawings.
- H. Reinforcing shall not be straightened or rebent unless specifically shown on the drawings. Bars with kinks or bends not shown on the Drawings shall not be used. Coiled reinforcement shall not be used.

### 3.05 SPLICING

- A. Reinforcing bar splices shall only be used at locations shown on the Drawings. When it is necessary to splice reinforcing at points other than where shown, the splice shall be as acceptable to the Engineer.
- B. The length of lap for reinforcing bars, unless otherwise shown on the Drawings shall be in accordance with ACI 318 for a class B splice.
- C. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

### 3.06 INSPECTION

- A. The Contractor shall advise the Engineer of his intentions to place concrete and shall allow him adequate time to inspect all reinforcing steel before concrete is placed.
- B. The Contractor shall advise the Engineer of his intentions to place grout in masonry walls and shall allow him adequate time to inspect all reinforcing steel before grout is placed.

### 3.07 CUTTING OF EMBEDDED REBAR

- A. The Contractor shall not cut embedded rebar cast into structural concrete without prior approval.

- - END OF SECTION - -



SECTION 03250  
CONCRETE ACCESSORIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor and equipment required to provide all concrete accessories including waterstops, expansion joint material, joint sealants, expansion joint seals, contraction joint inserts, and epoxy bonding agent.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300 Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
  - 1. ASTM C881 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
  - 1. Manufacturer's literature on all products specified herein including material certifications.
  - 2. Samples of products if requested by the Engineer.

PART 2 – PRODUCTS

2.01 EXPANDING RUBBER WATERSTOP

- A. Expanding rubber shall be designed to expand under hydrostatic conditions. Waterstops shall be Adeka Ultra Seal MC-2010M by Adeka Ultra Seal/OCM, Inc., or Hydrotite CJ-1020-2K by Sika Greenstreak, for concrete thickness greater than nine inches. For thicknesses less than nine inches, Adeka Ultra Seal KBA-1510FF or Hydrotite CJ-1020-2K shall be used.
- B. Waterstop shall be a chemically modified natural rubber product with a hydrophilic agent.
- C. Waterstop has a stainless steel mesh or coextrusion of non-hydrophilic rubber to direct expansion in the thickness direction and restrict the expansion in the longitudinal direction.

2.02 WATERSTOP ADHESIVE

- A. Adhesive between waterstops and existing concrete shall be 20+F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by JGF Adhesives, Sikadur 31 Hi-Mod Gel by Sika Corporation, DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

- B. Hydrophilic, non-bentonite water swelling elastic sealant shall be used to bond expanding rubber waterstops to rough surfaces. Hydrophilic elastic sealant shall be P-201 by Adeka Ultra Seal/OCM, Inc., Leakmaster LV-1 by Sika Greenstreak, or approved equal.

## 2.03 EXPANSION JOINT MATERIAL

- A. Preformed expansion joint material shall be non-extruding, and shall be of the following types:
  - 1. Type I-Sponge rubber, conforming to ASTM D1752, Type I.
  - 2. Type II-Cork, conforming to ASTM D1752, Type II.
  - 3. Type III-Self-expanding cork, conforming to ASTM D1752, Type III.
  - 4. Type IV-Bituminous fiber, conforming to ASTM Designation D1751.

## 2.04 EPOXY BONDING AGENT

- A. Epoxy bonding agent shall conform to ASTM C881 and shall be Sikadur 32 Hi-Mod, Sika Corporation, Lyndhurst, N.J.; Euco #452 Epoxy System, Euclid Chemical Company, Cleveland, OH, MasterInject 1500 by BASF Master Builder Solutions (BASF).

## 2.05 EPOXY RESIN BINDER

- A. Epoxy resin binder shall conform to the requirements of ASTM C-881, Type III, Grade 3, Class B and C for epoxy resin binder and shall be Sikadur 23, Low-Mod-Gel, manufactured by the Sika Corporation, Lyndhurst, N.J., Flexocrete Gel manufactured by DuraJoint Concrete Accessories or Euco #352 Gel, Euclid Chemical Company, MasterEmaco ADH 327 or 327 RS by BASF Master Builder Solutions.

# PART 3 – EXECUTION

## 3.01 EXPANDING RUBBER WATERSTOPS

- A. Waterstops shall be installed only where shown on the Drawings. Waterstops shall be installed in strict accordance with manufacturer's recommendations.

## 3.02 WATERSTOP ADHESIVE

- A. Adhesive shall be used where waterstops are attached to existing concrete surfaces. Adhesive shall be applied to both contact surfaces in strict accordance with manufacturer's recommendations.

## 3.03 INSTALLATION OF EXPANSION JOINT MATERIAL AND SEALANTS

- A. Type I, II, or III shall be used in all expansion joints in structures and concrete pavements unless specifically shown otherwise on the Drawings. Type IV shall be used in sidewalk and curbing and other locations specifically shown on the Drawings.
- B. All expansion joints exposed in the finish work, exterior and interior, shall be sealed with the specified joint sealant. Expansion joint material and sealants shall be installed in accordance with manufacturer's recommended procedures and as shown on the Drawings.
- C. Expansion joint material that will be exposed after removal of forms shall be cut and trimmed to ensure a neat appearance and shall completely fill the joint except for the space required



for the sealant. The material shall be held securely in place and no concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

- D. A bond breaker shall be used between expansion joint material and sealant. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surfaces shall present a clean and even appearance.
- E. Type 1 joint sealant shall be used in all expansion and contraction joints in concrete, except where Type 7 or Type 8 is required as stated below, and wherever else specified or shown on the Drawings. It shall be furnished in pour grade or gun grade depending on installation requirements. Primers shall be used as required by the manufacturer. The sealant shall be furnished in colors as directed by the Engineer.
- F. Type 8 joint sealant shall be used in all concrete pavements and floors subject to heavy traffic and wherever else specified or shown on the Drawings.
- G. Type 7 joint sealant shall be used for all joints in chlorine contact tanks and wherever specified or shown on the Drawings.

#### 3.04 EPOXY BONDING AGENT

- A. The Contractor shall use an epoxy bonding agent for bonding fresh concrete to existing concrete as shown on the Drawings.
- B. Bonding surface shall be clean, sound and free of all dust, laitance, grease, form release agents, curing compounds, and any other foreign particles.
- C. Application of bonding agent shall be in strict accordance with manufacturer's recommendations.
- D. Fresh concrete shall not be placed against existing concrete if epoxy bonding agent has lost its tackiness.

#### 3.05 EPOXY RESIN BINDER

- A. Epoxy resin binder shall be used to seal all existing rebar cut and burned off during demolition operations. Exposed rebar shall be burned back 1/2-inch minimum into existing concrete and the resulting void filled with epoxy resin binder.

- - END OF SECTION - -



## SECTION 03300

### CAST-IN-PLACE CONCRETE

#### PART 1 – - GENERAL

##### 1.01 THE REQUIREMENT

- A. Provide all labor, equipment, materials and services necessary for the manufacture, transportation and placement of all plain and reinforced concrete work, as shown on the Drawings or as ordered by the Engineer.
- B. The requirements in this section shall apply to the following types of concrete:
  - 1. Class A1 Concrete: Normal weight structural concrete to be used in all structures qualifying as environmental concrete structures that are designed in accordance with ACI 350 including pump stations, tanks, basins, process structures, and any structures containing fluid or process chemicals or other materials used in treatment process.
  - 2. Class B Concrete: Normal weight structural concrete used for duct bank encasements, catch basins, fence and guard post embedment, concrete fill, and other areas where specifically noted on Contract Drawings.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03200 - Reinforcing Steel
- B. Section 03250 - Concrete Accessories
- C. Section 03350 - Concrete Finishes
- D. Section 03370 - Concrete Curing
- E. Section 03600 - Grout

##### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
  - 1. International Building Code
  - 2. ACI 214 Recommended Practice for Evaluation of Strength Test Results of Concrete
  - 3. ACI 301 Specifications for Structural Concrete for Buildings
  - 4. ACI 304 Guide for Measuring, Mixing, Transporting, and Placing Concrete
  - 5. ACI 305 Hot Weather Concreting
  - 6. ACI 306 Cold Weather Concreting
  - 7. ACI 309 Recommended Practice for Consolidation of Concrete
  - 8. ACI 318 Building Code Requirements for Structural Concrete

9. ACI 350 Code Requirements for Environmental Engineering Concrete Structures
10. ASTM C 31 Standard Methods of Making and Curing Concrete Test Specimens in the Field
11. ASTM C 33 Standard Specification for Concrete Aggregates
12. ASTM C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
13. ASTM C 42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
14. ASTM C 88 Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate
15. ASTM C 94 Standard Specification for Ready-Mixed Concrete
16. ASTM C 114 Standard Test Method for Chemical Analysis of Hydraulic Cement
17. ASTM C 136 Standard Method for Sieve Analysis of Fine and Coarse Aggregate
18. ASTM C 138 Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
19. ASTM C 143 Standard Test Method for Slump of Portland Cement Concrete
20. ASTM C 150 Standard Specification for Portland Cement
21. ASTM C 172 Standard Method of Sampling Fresh Concrete
22. ASTM C 192 Standard Method of Making and Curing Concrete Test Specimens in the Laboratory
23. ASTM C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
24. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete
25. ASTM C 295 Standard Guide for Petrographic Examination of Aggregates for Concrete
26. ASTM C 457 Standard Recommended Practice for Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete
27. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
28. ASTM C 595 Standard Specification for Blended Hydraulic Cements
29. ASTM C 618 Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete
30. ASTM C 989 Standard Specification for Slag Cement for Use in Concrete and Mortars
31. ASTM C 1077 Recommended Practice for Labs Testing Concrete
32. ASTM C 1260 Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)
33. ASTM C 1567 Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
34. ASTM C 1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
35. ASTM C 1778 Reducing the Risk of Deleterious Alkali – Aggregate Reaction in Concrete

#### 1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
  1. Sources of all materials and certifications of compliance with specifications for all materials.
  2. Certified current (less than 1 year old) chemical analysis of the Portland Cement or Blended Cement to be used.
  3. Certified current (less than 1 year old) chemical analysis of fly ash or slag cement to be used.

4. Aggregate test results showing compliance with required standards, i.e., sieve analysis, aggregate soundness tests, petrographic analysis, mortar bar expansion testing, etc.
5. Manufacturer's data on all admixtures stating compliance with required standards.
6. Concrete mix design for each class of concrete specified herein.
7. Field experience records and/or trial mix data for the proposed concrete mixes for each class of concrete specified herein.

#### 1.05 QUALITY ASSURANCE

- A. Tests on materials used in the production of concrete shall be required as specified in PRODUCTS. These tests shall be performed by an independent testing laboratory approved by the Engineer at no additional cost to the Owner.
- B. Trial concrete mixes shall be tested when required in accordance with Article 3.01 at no additional cost to the Owner.
- C. Field quality control tests, as specified in Article 3.10, unless otherwise stated, will be performed by a materials testing consultant employed by the Owner. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. Any individual who samples and tests concrete to determine if the concrete is being produced in accordance with this Specification shall be certified as a Concrete Field Testing Technician, Grade I, in accordance with ACI CP-2. Testing laboratory shall conform to requirements of ASTM C-1077.

### PART 2 – PRODUCTS

#### 2.01 HYDRAULIC CEMENT

- A. Portland Cement
  1. Portland Cement shall be Type II conforming to ASTM C 150. Type I cement may be used provided either fly ash or slag cement is also included in the mix in accordance with Articles 2.02 or 2.03 respectively.
  2. When potentially reactive aggregates as defined in Article 2.05 are to be used in concrete mix, cement shall meet the following requirements:
    - a. For concrete mixed with only Portland Cement, the total alkalies in the cement (calculated as the percentage of  $Na_2O$  plus 0.658 times the percentage of  $K_2O$ ) shall not exceed 0.40%.
    - b. For concrete mixed with Portland Cement and an appropriate amount of fly ash (Article 2.02) or slag cement (Article 2.03) the total alkalies in the Portland Cement (calculated as the percentage of  $Na_2O$  plus 0.658 times the percentage of  $K_2O$ ) shall not exceed 0.85%.
  3. When non-reactive aggregates as defined in Article 2.05 are used in concrete mix, total alkalies in the cement shall not exceed 1.0%.

4. The proposed Portland Cement shall not contain more than 8% tricalcium aluminate and more than 12% tetracalcium aluminoferrite.

B. Blended Cement

1. Blended cements shall be Type IP (Portland Fly Ash Cement) or Type IS (Portland Slag Cement) conforming to ASTM C 595.
2. Type IP cement shall be an interground blend of Portland Cement and fly ash in which the fly ash constituent is between 15% and 25% of the weight of the total blend.
3. Type IS cement shall be an interground blend of Portland Cement and slag cement in which the slag constituent is between 35% and 50% of the weight of the total blend.
4. Fly ash and slag cement used in the production of blended cements shall meet the requirements of Articles 2.02 and 2.03, respectively.
5. When reactive aggregates as defined in Article 2.05 are used in concrete mix, the total alkalis in the Portland Cement (calculated as the percentage of Na<sub>2</sub>O plus 0.658 times the percentage of K<sub>2</sub>O) shall not exceed 0.85%. The percentage of fly ash or slag cement shall be set to meet provisions of Article 2.05.G.2.

C. Different types of cement shall not be mixed nor shall they be used alternately except when authorized in writing by the Engineer. Different brands of cement or the same brand from different mills may be used alternately. A resubmittal will be required if different cements are proposed during the Project.

D. Cement shall be stored in a suitable weather-tight building so as to prevent deterioration or contamination. Cement which has become caked, partially hydrated, or otherwise damaged will be rejected.

2.02 FLY ASH

- A. Fly ash shall meet the requirements of ASTM C 618 for Class F, except that the loss on ignition shall not exceed 4%. Fly ash shall also meet the optional physical requirements for uniformity as shown in Table 3 of ASTM C 618.
- B. For fly ash to be used in the production of type IP cement, the Pozzolan Activity Index shall be greater than 75% as specified in Table 3 of ASTM C 595.
- C. Where reactive aggregates as defined in Article 2.05 are used in concrete mix, the fly ash constituent shall be between 15% and 25% of the total weight of the combined Portland Cement and fly ash. The percentage of fly ash shall be set to meet the provisions of Article 2.05.G.2.
- D. For Type A1 concrete as required for use in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.
- E. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.

## 2.03 SLAG CEMENT

- A. Slag cement shall meet the requirements of ASTM C 989 including tests for effectiveness of slag in preventing excessive expansion due to alkali-aggregate reactivity as described in Appendix X-3 of ASTM C 989.
- B. Where reactive aggregates as defined in Article 2.05 are used in concrete mix, the slag cement constituent shall be between 35% and 40% of the total weight of the combined Portland Cement and slag. The percentage of slag cement shall be set to meet the provisions of Article 2.05.G.2.
- C. For Type A1 concrete as required for use in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.
- D. Additional slag cement shall not be included in concrete mixed with type IS or IP cement.

## 2.04 WATER

- A. Water used for mixing concrete shall be clear, potable and free from deleterious substances such as objectionable quantities of silty organic matter, alkali, salts and other impurities.
- B. Water shall not contain more than 100 PPM chloride.
- C. Water shall not contain more than 500 PPM dissolved solids.
- D. Water shall have a pH in the range of 4.5 to 8.5.
- E. Water shall meet requirements of ASTM C 1602.

## 2.05 AGGREGATES

- A. All aggregates used in normal weight concrete shall conform to ASTM C 33.
- B. Fine Aggregate (Sand) in the various concrete mixes shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the limits of ASTM C 33.
- C. Coarse aggregates shall consist of hard, clean, durable gravel, crushed gravel or crushed rock. Coarse aggregate shall be size #57 or #67 as graded within the limits given in ASTM C 33 unless otherwise specified.
- D. For Class A4 concrete, coarse aggregate shall be Size #8 in accordance with ASTM C33.
- E. Aggregates shall be tested for gradation by sieve analysis tests in conformance with ASTM C 136.
- F. Aggregates shall be tested for soundness in accordance with ASTM C 88. The loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using either magnesium sulfate or sodium sulfate.
- G. Non-reactive aggregates shall meet the following requirements:

1. All aggregates shall be evaluated in accordance with ASTM C 1778 to determine potential reactivity.
2. A petrographic analysis in accordance with ASTM C295 shall be performed to identify the constituents of the fine and coarse aggregate. Non-reactive aggregates shall meet the following limitations:
  - 1) (Optically strained, microfractured, or microcrystalline quartz, 5.0%, maximum.
  - 2) (Chert or chalcedony, 3.0%, maximum.
  - 3) (Tridymite or cristobalite, 1.0%, maximum.
  - 4) (Opal, 0.5%, maximum.
  - 5) (Natural volcanic glass in volcanic rocks, 3.0%, maximum.
3. If aggregates are deemed potentially reactive as per ASTM C-1778 and fly ash or slag cement is included in proposed concrete mix design, proposed concrete mix including proposed aggregates shall be evaluated by ASTM C-1567. Mean mortar bar expansions at 16 days shall be less than 0.08%. Tests shall be made using exact proportion of all materials proposed for use on the job in design mix submitted.
4. If aggregates are deemed potentially reactive as per ASTM C-1778 and a straight cement mix without fly ash or slag cement is proposed for concrete mix design, aggregates shall be evaluated by ASTM C-1260. Mean mortar bar expansions at 16 days shall be less than 0.08%.
- H. All aggregates shall be considered reactive unless they meet the requirements above for non-reactive aggregates. Aggregates with a lithology essentially similar to sources in the same region found to be reactive in service shall be considered reactive regardless of the results of the tests above.
- I. Contractor shall submit a new trial mix to the Engineer for approval whenever a different aggregate or gradation is proposed.

## 2.06 ADMIXTURES

- A. Air entraining agent shall be added to all concrete unless noted otherwise. The agent shall consist of a neutralized vinsol resin solution or a purified hydrocarbon with a cement catalyst which will provide entrained air in the concrete in accordance with ASTM C 260. The admixture proposed shall be selected in advance so that adequate samples may be obtained and the required tests made. Air content of concrete, when placed, shall be within the ranges given in the concrete mix design.
- B. The following admixtures are required or used for water reduction, slump increase, and/or adjustment of initial set. Admixtures permitted shall conform to the requirements of ASTM C 494. Admixtures shall be non-toxic after 30 days and shall be compatible with and made by the same manufacturer as the air-entraining admixtures.
  1. Water reducing admixture shall conform to ASTM C 494, Type A and shall contain no more than 0.05% chloride ions. Acceptable products are "Eucon Series" by the Euclid Chemical Company, "Master Pozzolite Series" by BASF, and "Plastocrete Series" by Sika Corporation.



2. High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G. The high range water reducer shall be added to the concrete at either the batch plant or at the job site and may be used in conjunction with a water reducing admixture. The high range water reducer shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system. Concrete shall be mixed at mixing speed for a minimum of 100 mixer revolutions after the addition of the high range water reducer. Acceptable products are "Eucon 37" or Plastol 5000 by the Euclid Chemical Company, "Master Rheobuild 1000 or Master Glenium Series" by BASF, and "Daracem 100 or Advaflo Series" by W.R. Grace.
  3. A non-chloride, non-corrosive accelerating admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C 494, Type C or E, and shall not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Acceptable products are "Accelguard 80/90 or NCA" by the Euclid Chemical Company and "Daraset" by W.R. Grace.
  4. A water reducing retarding admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C494, Type D and shall not contain more than 0.05% chloride ions. Acceptable products are "Eucon NR or Eucon Retarder 100" by the Euclid Chemical Company, "Pozzoloth Retarder" by BASF, and "Plastiment" by Sika Corporation.
- C. Admixtures containing calcium chloride, thiocyanate or more than 0.05 percent chloride ions are not permitted. The addition of admixtures to prevent freezing is not permitted.
- D. The Contractor shall submit manufacturer's data including the chloride ion content of each admixture and certification from the admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned prior to mix design review.

## 2.07 CONCRETE MIX DESIGN

- A. The proportions of cement, aggregates, admixtures and water used in the concrete mixes shall be based on the results of field experience or preferably laboratory trial mixes in conformance with Section 5.3. "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350. When trial mixes are used they shall also conform to Article 3.01 of this Section of the Specifications. If field experience records are used, concrete strength results shall be from concrete mixed with all of the ingredients proposed for use on job used in similar proportions to mix proposed for use on job. Contractor shall submit verification confirming this stipulation has been followed. Field experience records and/or trial mix data used as the basis for the proposed concrete mix design shall be submitted to the Engineer along with the proposed mix.
- B. Structural concrete shall conform to the following requirements. Cementitious materials refer to the total combined weight of all cement, fly ash, and slag cement contained in the mix.
1. Compressive Strength (28-Day)
    - a. Concrete Class A1 4,500 psi (minimum)
    - b. Concrete Class B 3,000 psi (minimum)

- |    |   |         |         |
|----|---|---------|---------|
| 2. | Water/cementitious materials ratio, by weight |         |         |
|    |   | Maximum | Minimum |
| a. | Concrete Class A1                             | 0.42    | 0.39    |
| c. | Concrete Class B                              | 0.50    | 0.39    |
- 
- |    |             |  |  |
|----|-------------|--|--|
| 3. | Slump range | 4" nominal unless high range water reducing admixture is used.<br>8" max if high range water reducing admixture is used. |  |
|----|-------------|--|--|
- 
- |    |             |                            |  |
|----|-------------|----------------------------|--|
| 4. | Air Content |                            |  |
| a. | Class A1    | 6% ±1.5%                   |  |
| b. | B           | 3% Max (non air-entrained) |  |

### PART 3 – EXECUTION

#### 3.01 TRIAL MIXES

- A. When trial mixes are used to confirm the quality of a proposed concrete mix in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350, an independent qualified testing laboratory designated and retained by the Contractor shall test a trial batch of each of the preliminary concrete mixes submitted by the Contractor. The trial batches shall be prepared using the aggregates, cement and admixtures proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain enough samples to satisfy requirements stated below. Tests on individual materials stated in PRODUCTS should already be performed before any trial mix is done. The cost of laboratory trial batch tests for each specified concrete mix will be borne by the Contractor and the Contractor shall furnish and deliver the materials to the testing laboratory at no cost to the Owner.
  
- B. The independent testing laboratory shall prepare a minimum of fifteen (15) standard test cylinders in accordance with ASTM C 31 in addition to conducting slump (ASTM C 143), air content (C 231) and unit weight (C 138) tests. Compressive strength test on the cylinders shall subsequently be performed by the same laboratory in accordance with ASTM C 39 as follows: Test 3 cylinders at age 7 days; test 3 cylinders at age 21 days; test 3 cylinders at age 28 days and test 3 cylinders at 56 days. The cylinders shall be carefully identified as "Trial Mix, Contract No. \_\_\_\_\_, Product \_\_\_\_\_." If the average 28-day compressive strength of the trial mix is less than that specified, or if any single cylinder falls below the required strength by more than 500 psi, the mix shall be corrected, another trial batch prepared, test cylinders taken, and new tests performed as before. Any such additional trial batch testing required shall be performed at no additional cost to the Owner. Adjustments to the mix shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor.

### 3.02 PRODUCTION OF CONCRETE

- A. All concrete shall be machine mixed. Hand mixing of concrete will not be permitted. The Contractor may supply concrete from a ready mix plant or from a site mixed plant. In selecting the source for concrete production the Contractor shall carefully consider its capability for providing quality concrete at a rate commensurate with the requirements of the placements so that well bonded, homogenous concrete, free of cold joints, is assured.
- B. Ready-Mixed Concrete
  - 1. At the Contractor's option, ready-mixed concrete may be used meeting the requirements for materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.
  - 2. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
  - 3. Each batch of concrete shall be mixed in a truck mixer for not less than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.
  - 4. Truck mixers and their operation shall be such that the concrete throughout the mixed batch, as discharged, is within acceptable limits of uniformity with respect to consistency, mix and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
  - 5. Ready-mixed concrete shall be delivered to the site for the work and discharge shall be completed before the drum has been revolved 300 revolutions and within the time requirements stated in Article 3.03 of this Section.
  - 6. Each and every concrete delivery shall be accompanied by a delivery ticket containing at least the following information:
    - a. Date and truck number
    - b. Ticket number
    - c. Mix designation of concrete
    - d. Cubic yards of concrete
    - e. Cement brand, type and weight in pounds
    - f. Weight in pounds of fine aggregate (sand)
    - g. Weight in pounds of coarse aggregate (stone)
    - h. Air entraining agent, brand, and weight in pounds and ounces

- i. Other admixtures, brand, and weight in pounds and ounces
  - j. Water, in gallons, stored in attached tank
  - k. Water, in gallons, maximum that can be added without exceeding design water/cementitious materials ratio
  - l. Water, in gallons, actually used (by truck driver)
  - m. Time of loading
  - n. Time of delivery to job (by truck driver)
7. Any truck delivering concrete to the job site, which is not accompanied by a delivery ticket showing the above information will be rejected and such truck shall immediately depart from the job site.
  8. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Engineer.

C. Site Mixed Concrete

1. Scales for weighing concrete ingredients shall be accurate when in use within  $\pm 0.4$  percent of their total capacities. Standard test weights shall be available to permit checking scale accuracy.
2. Operation of batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances:
  - a. Cement, fly ash, or slag cement  $\pm 1$  percent
  - b. Water  $\pm 1$  percent
  - c. Aggregates  $\pm 2$  percent
  - d. Admixtures  $\pm 3$  percent
3. Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue for a period which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to prevent batched ingredients from entering the mixer before the previous batch has been completely discharged.
4. The concrete shall be mixed in a batch mixer capable of thoroughly combining the aggregates, cement, and water into a uniform mass within the specified mixing time, and of discharging the concrete without harmful segregation. The mixer shall bear a manufacturer's rating plate indicating the rate capacity and the recommended revolutions per minute and shall be operated in accordance therewith.
5. Mixers with a rate capacity of 1 cu.yd. or larger shall conform to the requirements of the Plant Mixer Manufacturers' Division of the Concrete Plant Manufacturers' Bureau.
6. Except as provided below, batches of 1 cu. yd. or less shall be mixed for not less than 1 minute. The mixing time shall be increased 15 seconds for each cubic yard or fraction thereof of additional capacity.

7. Shorter mixing time may be permitted provided performance tests made in accordance with of ASTM C 94 indicate that the time is sufficient to produce uniform concrete.
8. Controls shall be provided to insure that the batch cannot be discharged until the required mixing time has elapsed. At least three-quarters of the required mixing time shall take place after the last of the mixing water has been added.
9. The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixer blades shall be replaced when they have lost 10 percent of their original height.
10. Air-entraining admixtures and other chemical admixtures shall be charged into the mixer as solutions and shall be measured by means of an approved mechanical dispensing device. The liquid shall be considered a part of the mixing water. Admixtures that cannot be added in solution may be weighed or may be measured by volume if so recommended by the manufacturer.
11. If two or more admixtures are used in the concrete, they shall be added separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.
12. Addition of retarding admixtures shall be completed within 1 minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first. Retarding admixtures shall not be used unless approved by the Engineer.
13. Concrete shall be mixed only in quantities for immediate use and within the time and mixing requirements of ASTM C 94.

### 3.03 CONCRETE PLACEMENT

- A. No concrete shall be placed prior to approval of the concrete mix design. Concrete placement shall conform to the recommendations of ACI 304.
- B. Prior to concrete placement, all reinforcement shall be securely and properly fastened in its correct position. Formwork shall be clean, oiled and form ties at construction joints shall be retightened. All bucks, sleeves, castings, hangers, pipe, conduits, bolts, anchors, wire, and any other fixtures required to be embedded therein shall be in place. Forms for openings to be left in the concrete shall be in place and anchored by the Contractor. All loose debris in bottoms of forms or in keyways shall be removed and all debris, water, snow, ice and foreign matter shall be removed from the space to be occupied by the concrete. The Contractor shall notify the Engineer in advance of placement, allowing sufficient time for a concurrent inspection and for any corrective measures which are subsequently required.
- C. On horizontal joints where concrete is to be placed on hardened concrete, flowing concrete containing a high range water reducing admixture or cement grout shall be placed with a slump not less than 8 inches for the initial placement at the base of the wall. Concrete or cement grout shall meet all strength and service requirements specified herein for applicable class of concrete. This concrete shall be worked well into the irregularities of the hard surface.

- D. All concrete shall be placed during the daylight hours except with the consent of the Engineer. If special permission is obtained to carry on work during the night, adequate lighting must be provided.
- E. When concrete arrives at the project with slump below that suitable for placing, as indicated by the Specifications, water may be added to bring the concrete within the specified slump range provided that the design water-cementitious materials ratio is not exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. Water may be added only to full trucks. On-site tempering shall not relieve the Contractor from furnishing a concrete mix that meets all specified requirements.
- F. Concrete shall be conveyed as rapidly as practicable to the point of deposit by methods which prevent the separation or loss of the ingredients. It shall be so deposited that rehandling will be unnecessary. Discharge of the concrete to its point of deposit shall be completed within 90 minutes after the addition of the cement to the aggregates. In hot weather, or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed the requirements stated in Article 3.09 of this Section.
- G. Where concrete is conveyed to position by chutes, a practically continuous flow in the chute shall be maintained. The angle and discharge arrangement of the chute shall be such as to prevent segregation of the concrete ingredients. The delivery end of the chute shall be as close as possible to the point of deposit and in no case shall the free pour from the delivery end of the chute exceed five feet, unless approved otherwise.
- H. Special care must be exercised to prevent splashing of forms or reinforcement with concrete, and any such splashes or accumulations of hardened or partially hardened concrete on the forms or reinforcement above the general level of the concrete already in place must be removed before the work proceeds. Concrete shall be placed in all forms in such way as to prevent any segregation.
- I. Placing of concrete shall be so regulated that the pressure caused by the wet concrete shall not exceed that used in the design of the forms.
- J. All concrete for walls shall be placed through openings in the form spaced at frequent intervals or through tremies (heavy duct canvas, rubber, etc.), equipped with suitable hopper heads. Tremies shall be of variable lengths so the free fall shall not exceed five (5) feet and a sufficient number shall be placed in the form to ensure the concrete is kept level at all times.
- K. When placing concrete which is to be exposed, sufficient illumination shall be provided in the interior of the forms so the concrete, at places of deposit, is visible from deck and runways.
- L. Concrete shall be placed so as to thoroughly embed all reinforcement, inserts, and fixtures.
- M. When forms are removed, surfaces shall be even and dense, free from aggregate pockets or honeycomb. To achieve this, concrete shall be consolidated using mechanical vibration, supplemented by forking and spading by hand in the corners and angle of forms and along form surfaces while the concrete is plastic under the vibratory action. Consolidation shall conform to ACI 309.
- N. Mechanical vibration shall be applied directly to the concrete, unless otherwise approved by the Engineer. The bottom of vibrators used on floor slabs must not be permitted to ride the

form supporting the slab. Vibration shall be applied at the point of deposit and in the area of freshly placed concrete by a vertical penetration of the vibrator. Vibrators shall not be used to move concrete laterally within the forms.

- O. The intensity of vibration shall be sufficient to cause settlement of the concrete into place and to produce monolithic joining with the preceding layer. It shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures with a vibrator transmitting not less than 7,500 impulses per minute. Since the duration of vibration per square foot of surface is dependent on the frequency (impulses per minute), size of vibrator, and slump of concrete, the length of time must therefore be determined in the field. Vibration, however, shall not be continued in any one location to the extent that pools of grout are formed.
- P. Care shall be taken to prevent cold joints when placing concrete in any portion of the work. The concrete placing rate shall be such as to ensure that each layer is placed while the previous layer is soft or plastic, so that the two layers can be made monolithic by penetration of the vibrators. Maximum thickness of concrete layers shall be 18 inches. The surface of the concrete shall be level whenever a run of concrete is stopped.
- Q. To prevent feathered edges, construction joints located at the tops of horizontal lifts near sloping exposed concrete surfaces shall be inclined near the exposed surface, so the angle between such inclined surface and the exposed concrete surface will be not less than 50°.
- R. In placing unformed concrete on slopes, the concrete shall be placed ahead of a non-vibrated slip-form screed extending approximately 2-1/2 feet back from its leading edge. The method of placement shall provide a uniform finished surface with the deviation from the straight line less than 1/8 inch in any concrete placement. Concrete ahead of the slip-form screed shall be consolidated by internal vibrators so as to ensure complete filling under the slip-form. Prior to placement of concrete on sloped walls or slabs, the Contractor shall submit a plan specifically detailing methods and sequence of placements, proposed concrete screed equipment, location of construction joints and waterstops, and/or any proposed deviations from the aforementioned to the Engineer for review and approval.
- S. Concrete shall not be placed during rains sufficiently heavy or prolonged to wash mortar from coarse aggregate on the forward slopes of the placement. Once placement of concrete has commenced in a block, placement shall not be interrupted by diverting the placing equipment to other uses.

#### 3.04 PLACING FLOOR SLABS ON GRADE

- A. The subgrade for slabs on ground shall be well drained and of adequate and uniform loadbearing nature. The in place density of the subgrade soils shall be at least the minimum required by the specifications. No foundation, slab, or pavement concrete shall be placed until the depth and character of the foundation soils have been inspected and approved by the materials testing consultant.
- B. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing it shall be raised and maintained above 50° long enough to remove all frost from the subgrade.
- C. The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.

- D. Thirty pound felt paper shall be provided between edges of slab on grade and vertical and horizontal concrete surfaces, unless otherwise indicated on the Drawings.
- E. Contraction joints shall be provided in slabs-on-grade at locations indicated on the Drawings. Contraction joints shall be installed as per Section 03290 - Joints in Concrete.
- F. Floor slabs shall be screeded level or pitched to drain as indicated on the Drawings. Finishes shall conform with requirements of Section 03350 - Concrete Finishes. Interior floor slabs shall be placed with non-air-entrained concrete (Class A3) if a steel troweled or hardened finish is required.

### 3.05 PLACING CONCRETE UNDERWATER (CLASS A5 CONCRETE)

- A. Placing concrete underwater (tremie concrete) will be permitted only when shown on the Drawings. Concrete deposited under water shall be carefully placed in a compacted mass in final position by means of a tremie, a closed bottom dump bucket or other approved method. Care must be exercised to maintain still water at the point of deposit. Concrete shall not be placed in running water. Underwater formwork shall be watertight. The consistency of the concrete shall be regulated to prevent segregation of materials. The method of depositing concrete shall be regulated such that the concrete enters the mass of the previously placed concrete from within, displacing water with a minimum disturbance to the surface of the concrete.
- B. Tremie shall consist of a tube having a diameter of not less than 10 inches and constructed in sections having flanged couplings fitted with gaskets. The tremie shall be supported to permit free movement of the discharge and over the entire top surface of the work and shall permit rapid lowering when necessary to choke off or retard the flow. The discharge end shall be entirely sealed at all times and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper, the tremie shall be slightly raised, but not out of the concrete at the bottom, until the batch discharges to the bottom of the hopper. The flow shall then be stopped by lowering the tremie. The flow shall be continuous until the placement has been completed.

### 3.06 PLACING CONCRETE UNDER PRESSURE

- A. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall have the capacity for the operation. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. To obtain the least line resistance, the layout of the pipeline system shall contain a minimum number of bends with no change in pipe size. If two sizes of pipe must be used, the smaller diameter should be used at the pump end and the larger at the discharge end. When pumping is completed, the concrete remaining in the pipelines, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.
- B. Priming of the concrete pumping equipment shall be with cement grout only. Use of specialty mix pump primers or pumping aids will not be allowed.
- C. No aluminum parts shall be in contact with the concrete during the entire placing of concrete under pressure at any time.
- D. Prior to placing concrete under pressure, the Contractor shall submit the concrete mix design together with test results from a materials testing consultant proving the proposed mix meets all requirements. In addition, an actual pumping test under field conditions is required prior to



acceptance of the mix. This test requires a duplication of anticipated site conditions from beginning to end. The batching and truck mixing shall be the same as will be used; the same pump and operator shall be present and the pipe and pipe layouts will reflect the maximum height and distance contemplated. All submissions shall be subject to approval by the Engineer.

- E. If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- F. The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the site during pumping.
- G. The minimum diameter of the hose (conduits) shall be four inches.
- H. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.
- I. Concrete samples for quality control in accordance with Article 3.10 will be taken at the placement (discharge) end of the line.

### 3.07 ORDER OF PLACING CONCRETE

- A. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the Drawings and maximum lengths as indicated on Drawings. Where required on the Drawings and wherever else practical, the placing of such units shall be done in a strip pattern in accordance with ACI 302.1. A minimum of 72 hours shall pass prior to placing concrete directly adjacent to previously placed concrete.

### 3.08 CONCRETE WORK IN COLD WEATHER

- A. Cold weather concreting procedures shall conform to the requirements of ACI 306.
- B. The Engineer may prohibit the placing of concrete at any time when air temperature is 40°F. or lower. If concrete work is permitted, the concrete shall have a minimum temperature, as placed, of 55°F. for placements less than 12" thick, 50°F. for placements 12" to 36" thick, and 45°F. for placements greater than 36" thick. The temperature of the concrete as placed shall not exceed the aforementioned minimum values by more than 20°F, unless otherwise approved by the Engineer.
- C. All aggregate and water shall be preheated. Precautions shall be taken to avoid the possibility of flash set when aggregate or water are heated to a temperature in excess of 100°F. in order to meet concrete temperature requirements. The addition of admixtures to the concrete to prevent freezing is not permitted. All reinforcement, forms, and concrete accessories with which the concrete is to come in contact shall be defrosted by an approved method. No concrete shall be placed on frozen ground.

### 3.09 CONCRETE WORK IN HOT WEATHER

- A. Hot weather concreting procedures shall conform to the requirements of ACI 305.
- B. When air temperatures exceed 85°F., or when extremely dry conditions exist even at lower temperatures, particularly if accompanied by high winds, the Contractor and his concrete

supplier shall exercise special and precautionary measures in preparing, delivering, placing, finishing, curing and protecting the concrete mix. The Contractor shall consult with the Engineer regarding such measures prior to each day's placing operation and the Engineer reserves the right to modify the proposed measures consistent with the requirements of this Section of the Specifications. All necessary materials and equipment shall be on hand and in position prior to each placing operation.

- C. Preparatory work at the job site shall include thorough wetting of all forms, reinforcing steel and, in the case of slab pours on ground or subgrade, spraying the ground surface on the preceding evening and again just prior to placing. No standing puddles of water shall be permitted in those areas which are to receive the concrete.
- D. The temperature of the concrete mix when placed shall not exceed 90°F.
- E. Temperature of mixing water and aggregates shall be carefully controlled and monitored at the supplier's plant, with haul distance to the job site being taken into account. Stockpiled aggregates shall, if necessary, be shaded from the sun and sprinkled intermittently with water. If ice is used in the mixing water for cooling purposes, it must be entirely melted prior to addition of the water to the dry mix.
- F. Delivery schedules shall be carefully planned in advance so that concrete is placed as soon as practical after it is properly mixed. For hot weather concrete work (air temperature greater than 85°F), discharge of the concrete to its point of deposit shall be completed within 60 minutes from the time the concrete is batched.
- G. The Contractor shall arrange for an ample work force to be on hand to accomplish transporting, vibrating, finishing, and covering of the fresh concrete as rapidly as possible.

### 3.10 QUALITY CONTROL

#### A. Field Testing of Concrete

- 1. The Contractor shall coordinate with the Engineer's project representative the on-site scheduling of the materials testing consultant personnel as required for concrete testing.
- 2. Concrete for testing shall be supplied by the Contractor at no additional cost to the Owner, and the Contractor shall provide assistance to the materials testing consultant in obtaining samples. The Contractor shall dispose of and clean up all excess material.

#### B. Consistency

- 1. The consistency of the concrete will be checked by the materials testing consultant by standard slump cone tests. The Contractor shall make any necessary adjustments in the mix as the Engineer and/or the materials testing consultant may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications. No payment shall be made for any delays, material or labor costs due to such eventualities.
- 2. Slump tests shall be made in accordance with ASTM C 143. Slump tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.

3. Concrete with a specified nominal slump shall be placed having a slump within 1" (higher or lower) of the specified slump. Concrete with a specified maximum slump shall be placed having a slump less than the specified slump.

C. Unit Weight

1. Samples of freshly mixed concrete shall be tested for unit weight by the materials testing consultant in accordance with ASTM C 138.
2. Unit weight tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

D. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the materials testing consultant in accordance with ASTM C 231.
2. Air content tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.
3. In the event test results are outside the limits specified, additional testing shall occur. Admixture quantity adjustments shall be made immediately upon discovery of incorrect air entrainment.

E. Compressive Strength

1. Samples of freshly mixed concrete will be taken by the materials testing consultant and tested for compressive strength in accordance with ASTM C 172, C 31 and C 39, except as modified herein.
2. In general, one sampling shall be taken for each placement in excess of five (5) cubic yards, with a minimum of one (1) sampling for each day of concrete placement operations, or for each one hundred (100) cubic yards of concrete, or for each 5,000 square feet of surface area for slabs or walls, whichever is greater.
3. Each sampling shall consist of at least five (5) 6x12 cylinders or (8) 4x8 cylinders. Each cylinder shall be identified by a tag, which shall be hooked or wired to the side of the container. The materials testing consultant will fill out the required information on the tag, and the Contractor shall satisfy himself that such information shown is correct.
4. The Contractor shall be required to furnish labor to the Owner for assisting in preparing test cylinders for testing. The Contractor shall provide approved curing boxes for storage of cylinders on site. The insulated curing box shall be of sufficient size and strength to contain all the specimens made in any four consecutive working days and to protect the specimens from falling over, being jarred or otherwise disturbed during the period of initial curing. The box shall be erected, furnished and maintained by the Contractor. Such box shall be equipped to provide the moisture and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C 31. Such box shall be located in an area free from vibration such as pile driving and traffic of all kinds and such that all specimen are shielded from direct sunlight and/or radiant heating sources. No concrete requiring inspection shall be delivered to the site until such storage curing box has been provided. Specimens shall remain undisturbed in the curing box until ready for delivery to the testing laboratory but not less than sixteen hours.

5. The Contractor shall be responsible for maintaining the temperatures of the curing box during the initial curing of test specimens with the temperature preserved between 60°F and 80°F as measured by a maximum-minimum thermometer. The Contractor shall maintain a written record of curing box temperatures for each day curing box contains test specimens. Temperature shall be recorded a minimum of three times a day with one recording at the start of the work day and one recording at the end of the work day.
6. When transported, the cylinders shall not be thrown, dropped, allowed to roll, or be damaged in any way.
7. Compression tests shall be performed in accordance with ASTM C 39. For 6x12 cylinders, two test cylinders will be tested at seven days and two at 28 days. For 4x8 cylinders, three test cylinders will be tested at seven days, three at 28 days. The remaining cylinders will be held to verify test results, if needed.

F. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 214, ACI 318, and ACI 350.
2. The strength level of concrete will be considered satisfactory if all of the following conditions are satisfied.
  - a. Every arithmetic average of any three consecutive strength tests equals or exceeds the minimum specified 28-day compressive strength for the mix (see Article 2.08).
  - b. No individual compressive strength test results falls below the minimum specified strength by more than 500 psi.
  - c. No more than 10% of the compressive tests have strengths greater than the maximum strength specified.
3. In the event any of the conditions listed above are not met, the mix proportions shall be corrected for the next concrete placing operation.
4. In the event that condition 2B is not met, additional tests in accordance with Article 3.10, paragraph H shall be performed.
5. When a ratio between 7-day and 28-day strengths has been established by these tests, the 7-day strengths shall subsequently be taken as a preliminary indication of the 28-day strengths. Should the 7-day test strength from any sampling be more than 10% below the established minimum strength, the Contractor shall:
  - a. Immediately provide additional periods of curing in the affected area from which the deficient test cylinders were taken.
  - b. Maintain or add temporary structural support as required.
  - c. Correct the mix for the next concrete placement operation, if required to remedy the situation.
6. All concrete which fails to meet the ACI requirements and these specifications is subject to removal and replacement at no additional cost to the Owner.

G. When non-compliant concrete is identified, test reports shall be sent immediately to the Engineer for review.

H. Additional Tests

1. When ordered by the Engineer, additional tests on in-place concrete shall be provided and paid for by the Contractor.
2. In the event the 28-day test cylinders fail to meet the minimum strength requirements as outlined in Article 3.10, paragraph F, the Contractor shall have concrete core specimens obtained and tested from the affected area immediately.
  - a. Three cores shall be taken for each sample in which the strength requirements were not met.
  - b. The drilled cores shall be obtained and tested in conformance with ASTM C 42. The tests shall be conducted by a materials testing consultant approved by the Engineer.
  - c. The location from which each core is taken shall be approved by the Engineer. Each core specimen shall be located, when possible, so its axis is perpendicular to the concrete surface and not near formed joints or obvious edges of a unit of deposit.
  - d. The core specimens shall be taken, if possible, so no reinforcing steel is within the confines of the core.
  - e. The diameter of core specimens should be at least 3 times the maximum nominal size of the coarse aggregate used in the concrete, but must be at least 2-inches in diameter.
  - f. The length of specimen, when capped, shall be at least twice the diameter of the specimen.
  - g. The core specimens shall be taken to the laboratory and when transported, shall not be thrown, dropped, allowed to roll, or damaged in any way.
  - h. Two (2) copies of test results shall be mailed directly to the Engineer. The concrete in question will be considered acceptable if the average compressive strength of a minimum of three test core specimens taken from a given area equal or exceed 85% of the specified 28-day strength and if the lowest core strength is greater than 75% of the specified 28-day strength.
3. In the event that concrete placed by the Contractor is suspected of not having proper air content, the Contractor shall engage a materials testing consultant approved by the Engineer, to obtain and test samples for air content in accordance with ASTM Specification C 457.
4. Concrete placed with compressive strengths greater than the maximum strength specified shall be removed and replaced or repaired as deemed necessary by the Engineer.

### 3.11 CARE AND REPAIR OF CONCRETE

- A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Care shall be exercised to avoid jarring forms or placing any strain on the ends of projecting reinforcing bars. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at no additional cost to the Owner.
- B. Areas of honeycomb shall be chipped back to sound concrete and repaired as directed.
- C. Concrete formwork blowouts or unacceptable deviations in tolerances for formed surfaces due to improperly constructed or misaligned formwork shall be repaired as directed. Bulging or protruding areas, which result from slipping or deflecting forms shall be ground flush or chipped out and redressed as directed.
- D. Areas of concrete in which cracking, spalling, or other signs of deterioration develop prior to final acceptance shall be removed and replaced, or repaired as directed. This stipulation includes concrete that has experienced cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an approved epoxy injection system. Non-structural cracks shall be repaired using an approved hydrophilic resin pressure injected grout system, unless other means of repair are deemed necessary and approved. All repair work shall be performed at no additional cost to the Owner.
- E. Concrete which fails to meet the strength requirements as outlined in Article 3.10, paragraph F, will be analyzed as to its adequacy based upon loading conditions, resultant stresses and exposure conditions for the particular area of concrete in question. If the concrete in question is found unacceptable based upon this analysis, that portion of the structure shall be strengthened or replaced by the Contractor at no additional cost to the Owner. The method of strengthening or extent of replacement shall be as directed by the Engineer.

- - END OF SECTION - -

SECTION 03350  
CONCRETE FINISHES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide finishes of all concrete surfaces specified herein and shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300 – Cast-in-Place Concrete
- B. Section 03600 – Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
  - 1. ACI 301 – Specifications for Structural Concrete for Buildings
  - 2. ACI 318 – Building Code Requirements for Structural Concrete

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
  - 1. Manufacturer's literature on all products specified herein.

PART 2 – PRODUCTS  
(NOT USED)

PART 3 – EXECUTION

3.01 FINISHES ON FORMED CONCRETE SURFACES

- A. After removal of forms, the finishes described below shall be applied in accordance with Article 3.05 - Concrete Finish Schedule. Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. The Engineer shall be the sole judge of acceptability of all concrete finish work.
  - 1. Type I - Rough: All fins, burrs, offsets, marks and all other projections left by the forms shall be removed. Projections, depressions, etc. below finished grade required to be

removed will only be those greater than 1/4-inch. All holes left by removal of ends of ties, and all other holes, depressions, bugholes, air/blow holes or voids shall be filled solid with cement grout after first being thoroughly wetted and then struck off flush. The only holes below grade to be filled will be tie holes and any other holes larger than 1/4-inch in any dimension. Honeycombs shall be chipped back to solid concrete and repaired as directed by the Engineer. All holes shall be filled with tools, such as sponge floats and trowels, that will permit packing the hole solidly with cement grout. Cement grout shall consist of one part cement to three parts sand, epoxy bonding agent (for tie holes only) and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface.

2. Type II - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type I finish. After the concrete has been predampened, a slurry consisting of one part cement (including an appropriate quantity of white cement in order to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Mix proportions shall be submitted to the Engineer after a sample of the work is established and accepted. Any surplus shall be removed by scraping and then rubbing with clean burlap.
3. Type III - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type II finish. No rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities requires it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted. A 100 square foot example shall be established at the beginning of the project to establish acceptability.

### 3.02 SLAB AND FLOOR FINISHES

- A. The finishes described below shall be applied to floors, slabs, flow channels and top of walls in accordance with Article 3.05 - Concrete Finish Schedule. The Engineer shall be the sole judge of acceptability of all such finish work.
  1. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required. When a Type "F" finish is subsequently to be applied, the surface of the screeded concrete shall be roughened with a concrete rake to 1/2" minimum deep grooves prior to final set.
  2. Type "B" - Wood or Magnesium Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood or magnesium float or until the desired texture is reached. Floating shall begin when the water sheen has disappeared and when the concrete has sufficiently hardened so that a person's foot leaves only a slight imprint. If wet spots occur, water shall be removed with a squeegee. Care shall be taken to prevent the formation of laitance and excess water on the finished surface. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finished surface shall be true, even, and free from blemishes and any other irregularities.



3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than that obtained with a wood float. It shall be obtained by power or band floating with cork floats.
4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas which are to receive a floor covering such as tile, resilient flooring, or carpeting, the applicable Specification Sections and Contract Drawings shall be reviewed for the required finishes and degree of flatness. In areas that are intermittently wet such as pump rooms, only one troweling operation is required to provide some trowel marks for slip resistance. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finish shall be brought to a smooth, dense surface, free from defects and blemishes.
5. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type "B" finish. All edges shall be edged with an 1/8-inch tool as directed by the Engineer.
6. Type "F" - Swept in Grout Topping: This finish shall be applied after a completion of a Type "A" finish. The concrete surface shall be properly cleaned, washed, and coated with a mixture of water and Portland Cement. Cement grout in accordance with Section 03600 shall then be plowed and swept into neat conformance with the blades or arms of the apparatus by turning or rotating the previously positioned mechanical equipment. Special attention shall be paid to true grades, shapes and tolerances as specified by the manufacturer of the equipment. Before beginning this finish, the Contractor shall notify the Engineer and the equipment manufacturer of the details of the operation and obtain approval and recommendations.
7. Type "G" Hardened Finish: This finish shall be applied after completion of a Type "B" or Type "C" finish and prior to application of a Type "D" finish. Hardeners shall be applied in strict accordance with the manufacturer's requirements. Hardeners shall be applied using a mechanical spreader. The hardener shall be applied in two shakes with the first shake comprising 2/3 of the total amount. Type "D" finish shall be applied following completion of application of the hardener.
  - a. Non-metallic floor hardener shall be applied where specifically required on the Contract Drawings at the rate of 1.0 pounds/ft.2.
  - b. Non-oxidizing heavy duty metallic floor hardener shall be applied at the loading docks and where specifically required on the Contract Drawings or specified herein at the rate of 1.5 pounds/ft.2.
8. Type "H" - Non-Slip Finish: This finish shall be provided by applying a non-slip flooring additive concurrently with the application of a Type "D" finish and/or installation of floor sealants. Application procedure shall be in accordance with manufacturer's instructions. Finish shall be applied where specifically required on the Contract Drawings or specified herein.
9. Type "J" - Raked Finish: This finish shall be provided by raking the surface as soon as the condition of the concrete permits by making depressions of  $\pm 1/4$  inch.

### 3.03 FINISHES ON EQUIPMENT PADS

- A. Formed surfaces of equipment pads shall receive a Type III finish.
- B. Top surfaces of equipment pads, except those surfaces subsequently required to receive grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive grout shall, before the concrete takes its final set, be made rough by removing the sand and cement that accumulates on the top to the extent that the aggregate will be exposed with irregular indentations in the surface up to 1/2 inch deep.

### 3.04 CONCRETE FINISH SCHEDULE

Item	Type of Finish
Exterior concrete walls below grade	I
Exterior exposed concrete walls, ceilings, beams, manholes, hand holes, miscellaneous structures and columns (including top of wall) to one foot below grade. All other exposed concrete surfaces not specified elsewhere	II
Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather	E

- - END OF SECTION - -

SECTION 03370  
CONCRETE CURING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Protect all freshly deposited concrete from premature drying and from the weather elements. The concrete shall be maintained with minimal moisture loss at a relatively constant temperature for a period of time necessary for the hydration of the cement and proper hardening of the concrete in accordance with the requirements specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300 – Cast-In-Place Concrete
- B. Section 03350 – Concrete Finishes

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
  - 1. ACI 301 – Specifications for Structural Concrete for Buildings
  - 2. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete
  - 3. ACI 305 – Hot Weather Concreting
  - 4. ACI 306 – Cold Weather Concreting
  - 5. ACI 308 – Standard Practice for Curing Concrete
  - 6. ASTM C171 – Standard Specifications for Sheet Materials for Curing Concrete
  - 7. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
  - 8. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
  - 1. Proposed normal procedures for protection and curing of concrete.

PART 2 – PRODUCTS  
(NOT USED)

PART 3 – EXECUTION

3.01 PROTECTION AND CURING

- A. All freshly placed concrete shall be protected from the elements, flowing water and from defacement of any nature during construction operations.
- B. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provision shall be made for maintaining the concrete in a moist condition for at least a 5-day period thereafter except for high early strength concrete, for which the period shall be at least the first three days after placement. Horizontal surfaces shall be kept covered, and intermittent, localized drying will not be permitted.
- C. Walls that will be exposed on one side with either fluid or earth backfill on the opposite side shall be continuously wet cured for a minimum of five days.
- D. The Contractor shall use one of the following methods to insure that the concrete remains in a moist condition for the minimum period stated above.
  - 1. Ponding or continuous fogging or sprinkling.
  - 2. Application of mats or fabric kept continuously wet.
  - 3. Continuous application of steam (under 150°F).
  - 4. Application of sheet materials conforming to ASTM C171.
- E. The Contractor shall keep absorbent wood forms wet until they are removed. After form removal, the concrete shall be cured by one of the methods in paragraph D.
- F. Any of the curing procedures used in Paragraph 3.01-D may be replaced by one of the other curing procedures listed in Paragraph 3.01-D after the concrete is one-day old. However, the concrete surface shall not be permitted to become dry at any time.

3.02 CURING CONCRETE UNDER COLD WEATHER CONDITIONS

- A. Suitable means shall be provided for a minimum of 72 hours after placing concrete to maintain it at or above the minimum as placed temperatures specified in Section 03300, Cast-In-Place Concrete, for concrete work in cold weather. During the 72-hour period, the concrete surface shall not be exposed to air more than 20°F above the minimum as placed temperatures.
- B. Stripping time for forms and supports shall be increased as necessary to allow for retardation in concrete strength caused by colder temperatures. This retardation is magnified when using concrete made with blended cements or containing fly ash or ground granulated blast furnace slag. Therefore, curing times and stripping times shall be further increased as necessary when using these types of concrete.

- C. The methods of protecting the concrete shall be approved by the Engineer and shall be such as will prevent local drying. Equipment and materials approved for this purpose shall be on the site in sufficient quantity before the work begins. The Contractor shall assist the Engineer by providing holes in the forms and the concrete in which thermometers can be placed to determine the adequacy of heating and protection. All such thermometers shall be furnished by the Contractor in quantity and type which the Engineer directs.
- D. Curing procedures during cold weather conditions shall conform to the requirements of ACI 306.

### 3.03 CURING CONCRETE UNDER HOT WEATHER CONDITIONS

- A. When air temperatures exceed 85°F, the Contractor shall take extra care in placing and finishing techniques to avoid formation of cold joints and plastic shrinkage cracking. If ordered by the Engineer, temporary sun shades and/or windbreakers shall be erected to guard against such developments, including generous use of wet burlap coverings and fog sprays to prevent drying out of the exposed concrete surfaces.
- B. Immediately after screeding, horizontal surfaces shall receive an application of evaporation reducer. Apply in accordance with manufacturer's instructions. Final finish work shall begin as soon as the mix has stiffened sufficiently to support the workmen.
- C. Curing and protection of the concrete shall begin immediately after completion of the finishing operation. Continuous moist-curing consisting of method 1 or 2 listed in paragraph 3.01D is mandatory for at least the first 24 hours. Method 2 may be used only if the finished surface is not marred or blemished during contact with the coverings.
- D. At the end of the initial 24-hour period, curing and protection of the concrete shall continue for at least six (6) additional days using one of the methods listed in paragraph 3.01D.
- E. Curing procedures during hot weather conditions shall conform to the requirements of ACI 305.

- - END OF SECTION - -



SECTION 03400  
PRECAST CONCRETE

PART 1 – GENERAL

1.01 REQUIREMENTS

- A. The Contractor shall construct all precast concrete items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02604 - Utility Structures
- B. Section 03200 - Reinforcing Steel
- C. Section 03300 - Cast-in-Place Concrete
- D. Section 03600 - Grout
- E. Section 05010 - Metal Materials
- F. Section 05050 - Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the end of the Bid.
  - 1. North Carolina Building Code
  - 2. ACI 318-Building Code Requirements for Structural Concrete
  - 3. PCI Standard MNL-116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products
  - 4. PCI Design Handbook

1.04 SUBMITTALS

- A. The Contractor shall submit the following for review in accordance with Section 01300, Submittals.
  - 1. Shop drawings for all precast concrete items showing all dimensions, locations, and type of lifting inserts, and details of reinforcement and joints.
  - 2. A list of the design criteria used by the manufacturer for all manufactured, precast items.

3. Design calculations, showing at least the design loads and stresses on the item, shall be submitted. Calculations shall be signed and sealed by a Professional Engineer registered in the State of North Carolina.
4. Certified reports for all lifting inserts, indicating allowable design loads.
5. Information on lifting and erection procedures.

#### 1.05 QUALITY ASSURANCE

- A. All manufactured precast concrete units shall be produced by an experienced manufacturer regularly engaged in the production of such items. All manufactured precast concrete and site-cast units shall be free of defects, spalls, and cracks. Care shall be taken in the mixing of materials, casting, curing and shipping to avoid any of the above. The Engineer may elect to examine the units at the casting yard or upon arrival of the same at the site. The Engineer shall have the option of rejecting any or all of the precast work if it does not meet with the requirements specified herein or on the Drawings. All rejected work shall be replaced at no additional cost to the Owner.

- B. Manufacturer Qualifications

The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, prior to the start of production. Certification is only required for plants providing prestressed structural members such as hollow core planks, double-T members, etc.

- C. Plant production and engineering must be under direct supervision and control of an Engineer who possesses a minimum of five years experience in precast concrete work.

### PART 2 – PRODUCTS

#### 2.01 CONCRETE

- A. Concrete materials including portland cement, aggregates, water, and admixtures shall conform to Section 03300, Cast-in-Place Concrete.
- B. For prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 5,000 psi unless otherwise specified. Minimum compressive strength of concrete at transfer of prestressing force shall be 3,500 psi unless otherwise specified.
- C. For non-prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 4000 psi unless otherwise specified.

#### 2.02 GROUT

- A. Grout for joints between panels shall be a cement grout in conformance with Section 03600, Grout.
- B. Minimum compressive strength of grout at 7 days shall be 3,000 psi.

#### 2.03 REINFORCING STEEL

- A. Reinforcing steel used for precast concrete construction shall conform to Section 03200, Reinforcing Steel.



## 2.04 PRESTRESSING STRANDS

- A. Prestressing strands shall be 7-wire, stress-relieved, high-strength strands Grade 250K or 270K in conformance with Section 03230, Stressing Tendons.

## 2.05 STEEL INSERTS

- A. Steel inserts shall be in accordance with Section 05010, Metal Materials.
- B. All steel inserts protruding from or occurring at the surface of precast units shall be galvanized.

## 2.06 WELDING

- A. Welding shall conform to Section 05050, Metal Fastening.

# PART 3 – EXECUTION

## 3.01 FABRICATION AND CASTING

- A. All precast members shall be fabricated and cast to the shapes, dimensions and lengths shown on the Drawings and in compliance with PCI MNL-116. Precast members shall be straight, true and free from dimensional distortions, except for camber and tolerances permitted later in this clause. All integral appurtenances, reinforcing, openings, etc., shall be accurately located and secured in position with the form work system. Form materials shall be steel and the systems free from leakage during the casting operation.
- B. All cover of reinforcing shall be the same as detailed on the Drawings.
- C. Because of the critical nature of the bond development length in prestressed concrete panel construction, if the transfer of stress is by burning of the fully tensioned strands at the ends of the member, each strand shall first be burned at the ends of the bed and then at each end of each member before proceeding to the next strand in the burning pattern.
- D. The Contractor shall coordinate the communication of all necessary information concerning openings, sleeves, or inserts to the manufacturer of the precast members.
- E. Concrete shall be finished in accordance with Section 03350, Concrete Finishes. Grout all recesses due to cut tendons which will not otherwise be grouted during erection.
- F. Curing of precast members shall be in accordance with Section 03370, Concrete Curing. Use of a membrane curing compound will not be allowed.
- G. The manufacturer shall provide lifting inserts or other approved means of lifting members.

## 3.02 HANDLING, TRANSPORTING AND STORING

- A. Precast members shall not be transported away from the casting yard until the concrete has reached the minimum required 28 day compressive strength and a period of at least 5 days has elapsed since casting, unless otherwise permitted by the Engineer.
- B. No precast member shall be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.

- C. During handling, transporting, and storing, precast concrete members shall be lifted and supported only at the lifting or supporting points as indicated on the shop drawings.
- D. All precast members shall be stored on solid, unyielding, storage blocks in a manner to prevent torsion, objectionable bending, and contact with the ground.
- E. Precast concrete members shall not be used as storage areas for other materials or equipment.
- F. Precast members damaged while being handled or transported will be rejected or shall be repaired in a manner approved by the Engineer.

### 3.03 ERECTION

- A. Erection shall be carried out by the manufacturer or under his supervision using labor, equipment, tools and materials required for proper execution of the work.
- B. Contractor shall prepare all bearing surfaces to a true and level line prior to erection. All supports of the precast members shall be accurately located and of required size and bearing materials.
- C. Installation of the precast members shall be made by leveling the top surface of the assembled units keeping the units tight and at right angles to the bearing surface.
- D. Connections which require welding shall be properly made in accordance with Section 05050, Metal Fastening.
- E. Grouting between adjacent precast members and along the edges of the assembled precast members shall be accomplished as indicated on the drawings, care being taken to solidly pack such spaces and to prevent leakage or droppings of grout through the assembled precast members. Any grout which seeps through the precast members shall be removed before it hardens.
- F. In no case shall concentrated construction loads, or construction loads exceeding the design loads, be placed on the precast members. In no case shall loads be placed on the precast members prior to the welding operations associated with erection, and prior to placing of topping (if required).
- G. No Contractor, Subcontractor or any of his employees shall arbitrarily cut, drill, punch or otherwise tamper with the precast members.
- H. Precast members damaged while being erected will be rejected or shall be repaired in a manner approved by the Engineer.

- - END OF SECTION - -

## SECTION 03600

### GROUT

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all grout used in concrete work and as bearing surfaces for base plates, in accordance with the Contract Documents.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Requirements of related work are included in Division 1 and Division 2 of these Specifications.

##### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1.	CRD-C 621	Corps of Engineers Specification for Non-shrink Grout
2.	ASTM C 109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cube Specimens)
3.	ASTM C 531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing
4.	ASTM C 579	Test Method for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacing
5.	ASTM C 827	Standard Test Method for Early Volume Change of Cementitious Mixtures
6.	ASTM C 144	Standard Specification for Aggregate for Masonry Mortar
7.	ASTM C 1107	Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

##### 1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 - Submittals.

1. Certified test results verifying the compressive strength and shrinkage and expansion requirements specified herein.
2. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

## 1.05 QUALITY ASSURANCE

### A. Field Tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications. The specimens will be made by the Engineer or its representative.
  - a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days and any additional time period as appropriate.
  - b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time period as appropriate.
2. The cost of all laboratory tests on grout will be borne by the Owner, but the Contractor shall assist the Engineer in obtaining specimens for testing. The Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The Contractor shall supply all materials necessary for fabricating the test specimens, at no additional cost to the Owner.
3. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

#### A. Cement Grout

1. Cement grout shall be composed of Portland Cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall consist of one part Portland Cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland Cement shall be mixed with the Portland Cement as required to match color of adjacent concrete.
2. The minimum compressive strength at 28 days shall be 4000 psi.
3. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8

inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness.

4. Sand shall conform to the requirements of ASTM C144.

B. Non-Shrink Grout

1. Non-shrink grout shall conform to CRD-C 621 and ASTM C 1107, Grade B or C when tested at a max. fluid consistency of 30 seconds per CDC 611/ASTM C939 at temperature extremes of 45°F and 90°F and an extended working time of 15 minutes. Grout shall have a min. 28-day strength of 7,000 psi. Non-shrink grout shall be, "Euco N-S" by the Euclid Chemical Company, "Sikagrout 212" by Sika Corporation, "Conspec 100 Non-Shrink Non-Metallic Grout" by Conspec, "Masterflow 555 Grout" by BASF Master Builder Solutions.

2.02 CURING MATERIALS

- A. Curing materials shall be as specified in Section 03370, Concrete Curing for cement grout and as recommended by the manufacturer for prepackaged grouts.

PART 3 – EXECUTION

3.01 GENERAL

- A. The different types of grout shall be used for the applications stated below unless noted otherwise in the Contract Documents. Where grout is called for in the Contract Documents which does not fall under any of the applications stated below, non-shrink grout shall be used unless another type is specifically referenced.
  1. Cement grout shall be used for grout toppings and for patching of fresh concrete.
  2. Non-shrink grout shall be used for grouting beneath base plates of structural metal framing.
- B. New concrete surfaces to receive cement grout shall be as specified in Section 03350, Concrete Finishes, and shall be cleaned of all dirt, grease and oil-like films. Existing concrete surfaces shall likewise be cleaned of all similar contamination and debris, including chipping or roughening the surface if a laitance or poor concrete is evident. The finish of the grout surface shall match that of the adjacent concrete. Curing and protection of cement grout shall be as specified in Section 03370, Concrete Curing.
- C. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- D. The Contractor, through the manufacturer of a non-shrink grout and epoxy grout, shall provide on-site technical assistance upon request, at no additional cost to the Owner.

### 3.02 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.

### 3.03 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

### 3.04 GROUT INSTALLATION

- A. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted and be thoroughly compacted and free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped. The use of pneumatic pressure or dry-packed grouting requires approval of the Engineer. For grouting beneath base plates, grout shall be poured from one side only and thence flow across to the open side to avoid air-entrapment.

- - END OF SECTION - -

SECTION 05010  
METAL MATERIALS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Metal materials not otherwise specified shall conform to the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Materials for fasteners are included in Section 05050, Metal Fastening.
- B. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- |    |           |  |
|----|-----------|--|
| A. | ASTM A36  | Standard Specification for Structural Steel  |
| B. | ASTM A47  | Standard Specification for Malleable Iron Castings   |
| C. | ASTM A48  | Standard Specification for Gray Iron Castings  |
| D. | ASTM A53  | Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless                          |
| E. | ASTM A167 | Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip                  |
| F. | ASTM A276 | Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes  |
| G. | ASTM A307 | Standard Specification for Carbon Steel Externally Threaded Standard Fasteners   |
| H. | ASTM A446 | Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) quality |
| I. | ASTM A500 | Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes         |
| J. | ASTM A501 | Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing                               |

- |    |            |   |
|----|------------|---|
| K. | ASTM A529  | Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness) |
| L. | ASTM A536  | Standard Specification for Ductile Iron Castings  |
| M. | ASTM A570  | Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality  |
| N. | ASTM A572  | Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel  |
| O. | ASTM A992  | Standard Specification for Structural Steel Shapes  |
| P. | ASTM A666  | Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications            |
| Q. | ASTM A1085 | Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)                                     |
| R. | ASTM B26   | Standard Specification for Aluminum-Alloy Sand Castings   |
| S. | ASTM B85   | Standard Specification for Aluminum-Alloy Die Castings  |
| T. | ASTM B108  | Standard Specification for Aluminum-Alloy Permanent Mold Castings   |
| U. | ASTM B138  | Standard Specification for Manganese Bronze Rod, Bar, and Shapes  |
| V. | ASTM B209  | Standard Specification for Aluminum-Alloy Sheet and Plate   |
| W. | ASTM B221  | Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes  |
| X. | ASTM B308  | Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded  |
| Y. | ASTM B574  | Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod   |
| Z. | ASTM F468  | Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use  |
| a. | ASTM F593  | Standard Specification for Stainless Steel Fasteners  |

#### 1.04 SUBMITTALS

- A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.

#### 1.05 QUALITY ASSURANCE

- A. Owner may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in



conformance with Specifications the cost of testing will be borne by the Owner. If the material does not conform to the Specifications, the cost of testing shall be paid by the Contractor and all materials not in conformance as determined by the Engineer shall be replaced by the Contractor at no additional cost to the Owner. In lieu of replacing materials the Contractor may request further testing to determine conformance, but any such testing shall be paid for by the Contractor regardless of outcome of such testing.

## PART 2 – PRODUCTS

### 2.01 STAINLESS STEEL

- A. All stainless steel fabrications exposed to underwater service shall be Type 316. All other stainless steel fabrications shall be Type 304, unless noted otherwise.
- B. Material types and ASTM designations are listed below:
  - 1. Plates and Sheets ASTM A167 or A666 Grade A
  - 2. Structural Shapes ASTM A276
  - 3. Fasteners (Bolts, etc.) ASTM F593

### 2.02 ALUMINUM

- A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.
- B. Material types and ASTM designations are listed below:
  - 1. Structural Shapes ASTM B308
  - 2. Castings ASTM B26, B85, or B108
  - 3. Extruded Bars ASTM B221 - Alloy 6061
  - 4. Extruded Rods, Shapes and Tubes ASTM B221 - Alloy 6063
  - 5. Plates ASTM B209 - Alloy 6061
  - 6. Sheets ASTM B221 - Alloy 3003
- C. All aluminum structural members shall conform to the requirements of Section 05140, Structural Aluminum.
- D. All aluminum shall be provided with mill finish unless otherwise noted.
- E. Where bolted connections are indicated, aluminum shall be fastened with stainless steel bolts.
- F. Aluminum in contact with dissimilar materials shall be insulated with an approved dielectric.

### 2.03 CAST IRON

- A. Material types and ASTM designations are listed below:

- |    |           |                          |
|----|-----------|--------------------------|
| 1. | Gray      | ASTM A48 Class 30B       |
| 2. | Malleable | ASTM A47                 |
| 3. | Ductile   | ASTM A536 Grade 60-40-18 |

PART 3 – EXECUTION  
(NOT USED)

- - END OF SECTION - -

SECTION 05050  
METAL FASTENING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 - Metal Materials

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

- |     |                              |  |
|-----|------------------------------|--|
| 1.  | North Carolina Building Code |  |
| 2.  | AC 193                       | Acceptance Criteria for Mechanical Anchors in Concrete Elements              |
| 3.  | AC 308                       | Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements |
| 4.  | ACI 318                      | Building Code Requirements for Structural Concrete                           |
| 5.  | ACI 355.2                    | Qualifications of Post-Installed Mechanical Anchors in Concrete              |
| 6.  | ACI 355.4                    | Qualifications of Post-Installed Adhesive Anchors in Concrete                |
| 7.  | AISC 348                     | The 2009 RCSC Specification for Structural Joints                            |
| 8.  | AISC                         | Code of Standard Practice  |
| 9.  | AWS D1.1                     | Structural Welding Code - Steel  |
| 10. | AWS D1.2                     | Structural Welding Code - Aluminum   |
| 11. | AWS D1.6                     | Structural Welding Code – Stainless Steel                                    |

12.	Aluminum Association	Specifications for Aluminum Structures
13.	ASTM A572/A572M-94C	Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50
14.	ASTM A36	Standard Specification for Carbon Structural Steel
15.	ASTM A325	Standard Specification for High-Strength Bolts for Structural Steel Joints
16.	ASTM A489	Standard Specification for Eyebolts
17.	ASTM A490	Standard Specification for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints
18.	ASTM A563	Standard Specifications for Carbon and Alloy Steel Nuts
19.	ASTM D1785	Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe
20.	ASTM E488	Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
21.	ASTM F436	Standard Specification for Hardened Steel Washers
22.	ASTM F467	Standard Specification for Nonferrous Nuts for General Use
23.	ASTM F593	Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs
24.	ASTM F594	Standard Specification for Stainless Steel Nuts
25.	ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

#### 1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.
2. Anchor design calculations sealed by a Professional Engineer currently registered in the State of North Carolina. Only required if design not shown on Contract Drawings.
3. Manufacturer's installation instructions.

4. Copy of valid certification for each person who is to perform field welding.
5. Certified weld inspection reports, when required.
6. Welding procedures.
7. Installer qualifications.
8. Certification of Installer Training.
9. Inspection Reports.
10. Results of Anchor Proof Testing.

#### 1.05 QUALITY ASSURANCE

- A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.
- B. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Concrete adhesive anchor installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.
- C. Installer Training: For concrete adhesive anchors, conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process to include but not be limited to the following:
  1. Hole drilling procedure.
  2. Hole preparation and cleaning technique.
  3. Adhesive injection technique and dispenser training/maintenance.
  4. Concrete adhesive anchor preparation and installation.
  5. Proof loading/torquing.
- D. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.
- E. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.
- F. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the Owner.

- G. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.

## PART 2 – PRODUCTS

### 2.01 ANCHOR RODS (ANCHOR BOLTS)

- A. Anchor rods shall conform to ASTM F1554 Grade 36 except where stainless steel or other approved anchor rods are shown on the Drawings. Anchor rods shall have hexagonal heads and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563 Grade A.
- B. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot-dip galvanized in accordance with ASTM F1554.
- C. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

### 2.02 STAINLESS STEEL BOLTS

- A. Stainless steel bolts shall conform to ASTM F-593. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.
- B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer, and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts shall be of the same alloy as the bolts.

### 2.03 CONCRETE ANCHORS

#### A. General

- 1. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. The determination of anchors equivalent to those listed below shall be on the basis of test data performed by an approved independent testing laboratory. There are two types used:
  - a. Expansion anchors shall be mechanical anchors of the wedge, sleeve, drop-in or undercut type.
  - b. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two part injection type using the manufacturer's static mixing nozzle and shall be supplied as an entire system.

2. Expansion anchors shall not be used to hang items from above or in any other situations where direct tension forces are induced in anchor.
3. Unless otherwise noted, all concrete anchors which are submerged or are used in hanging items or have direct tension induced upon them, or which are subject to vibration from equipment such as pumps and generators, shall be adhesive anchors.
4. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC 308. Expansion or mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193.
5. Fire Resistance: All anchors installed within fire resistant construction shall either be enclosed in a fire resistant envelope, be protected by approved fire-resistive materials, be used to resist wind and earthquake loads only, or anchor non-structural elements.
6. Engineer's approval is required for use of concrete anchors in locations other than those shown on the Drawings.

B. Concrete Anchor Design:

An anchor design consists of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads. Where an anchor design is indicated on the Drawings, it shall be considered an engineered design and anchors shall be installed to the prescribed size, spacing, embedment depth and edge distance. If all parts of an anchor design are provided on the Drawings except embedment depth, the anchors will be considered an engineered design and the Contractor shall provide the embedment depth as indicated in Paragraph B.3 unless otherwise directed by the Engineer. Where an anchor design is not indicated by the Engineer on the Drawings, the Contractor shall provide the anchor design per the requirements listed below.

1. Structural Anchors: All concrete anchors shall be considered structural anchors if they transmit load between structural elements; transmit load between non-structural components that make up a portion of the structure and structural elements; or transmit load between life-safety related attachments and structural elements. Examples of structural concrete anchors include but are not limited to column anchor bolts, anchors supporting non-structural walls, sprinkler piping support anchors, anchors supporting heavy, suspended piping or equipment, anchors supporting barrier rails, etc. For structural anchors, the Contractor shall submit an engineered design with signed and sealed calculations performed by an Engineer currently registered in the State of North Carolina. Structural anchors shall be of a type recommended by the anchor manufacturer for use in cracked concrete and shall be designed by the Contractor in accordance with ACI 318 Appendix D.
2. Non-Structural Anchors: All other concrete anchors may be considered non-structural concrete anchors. The Contractor shall perform an engineered design for non-structural anchors. The Engineer may request the Contractor provide anchor design details for review, but submission of a signed, sealed design is not required. Non-structural anchors shall be designed by the contractor for use in uncracked concrete.

### 3. Embedment Depth

- a. Minimum anchor embedment shall be as indicated on the Drawings or determined by the Contractor's engineered design. Although all manufacturers listed are permitted, the embedment depth indicated on the Drawings is based on "PE 1000+ by Powers Fasteners". If the contractor submits one of the other concrete adhesive anchors listed, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.
- b. Where the embedment depth is not shown on the Drawings, concrete anchors shall be embedded no less than the manufacturer's standard embedment (expansion or mechanical anchors) or to provide a minimum allowable bond strength equal to the allowable yield capacity of the rod according to the manufacturer (adhesive anchors).
- c. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum or more than the maximum stated in the manufacturer's literature.

### C. Structural Anchors:

#### 1. Mechanical Anchors:

- a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt TZ" by Hilti, Inc., "TruBolt +" by ITW Redhead, "Strong-Bolt 2" by Simpson Strong-Tie Co. or "Powerstud SD-1" or "Powerstud SD-2" by Powers Fasteners.
- b. Screw Anchors: Screw anchors shall be "Kwik HUS-EZ" and "KWIK HUS-EZ-I" by Hilti, Inc., "Titen HD" by Simpson Strong-Tie Co., or "Wedge-Bolt +" by Powers Fasteners. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.
- c. Sleeve Anchors: Sleeve anchors shall be "HSL-3 Heavy Duty Sleeve Anchor" by Hilti, Inc. or "Power-Bolt +" by Powers Fasteners.
- d. Undercut Anchors: Undercut anchors shall be "HDA Undercut Anchor" by Hilti, Inc., "Torq-Cut Undercut Anchor" by Simpson Strong-Tie Co., "Atomic + Undercut Anchor" by Powers Fasteners

#### 2. Adhesive Anchors:

- a. Adhesive anchors shall be "Epcon C6+ Adhesive Anchoring System" by ITW Redhead, "HIT HY-200 Adhesive Anchoring System" by Hilti, Inc., "AT-XP" or "SET-XP Epoxy Adhesive Anchors" by Simpson Strong-Tie Co., or "PE-1000+ Epoxy Adhesive Anchor System" by Powers Fasteners.
- b. Structural adhesive anchor systems shall be IBC compliant and capable of resisting short term wind and seismic loads (Seismic Design Categories A



through F) as well as long term and short term sustained static loads in both cracked and uncracked concrete in all Seismic Design Categories. Structural adhesive anchor systems shall comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report in accordance with the applicable building code. **No or equal products will be considered unless prequalified and approved by the Engineer and Owner.**

D. Non-Structural Anchors: In addition to the acceptable non-structural anchors listed below, all structural anchors listed above may also be used as non-structural anchors.

1. Mechanical Anchors:

- a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt 3" by Hilti, Inc., "Wedge-All" by Simpson Strong-Tie Co. or "TruBolt" by ITW Redhead.
- b. Screw Anchors: Screw anchors shall be "Kwik HUS" by Hilti, Inc., "Wedge-Bolt" by Powers Fasteners "Large Diameter Tapcon (LDT) Anchor" by ITW Redhead, or "Titen HD" by Simpson Strong-Tie Co. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.
- c. Sleeve Anchors: Sleeve anchors shall be "HSL Heavy Duty Sleeve Anchors" by Hilti, Inc. "Power-Bolt" by Powers Fasteners "Dynabolt Sleeve Anchor" by ITW Redhead, or "Sleeve-All" by Simpson Strong-Tie Co.
- d. Drop-In Anchors: Drop-in anchors shall be "Drop-In" by Simpson Strong-Tie Co., "HDI Drop-In Anchor" by Hilti, Inc. or "Multi-Set II Drop-In Anchor" by ITW Redhead.
- e. Undercut Anchors: Undercut anchors shall be "HDA Undercut Anchor" by Hilti, Inc., or "Torq-Cut" by Simpson Strong-Tie Co.

2. Adhesive Anchors:

- a. Adhesive anchors shall be "Epcon A7" or "Epcon C6+ Adhesive Anchoring System" by ITW Redhead, "HIT HY-200 Adhesive Anchoring System" by Hilti, Inc., "SET Epoxy Tie High Strength Anchoring Adhesive" or "AT High Strength Anchoring Adhesive" by Simpson Strong-Tie Co., or "Powers AC 100+ Gold Vinylester Injection Adhesive Anchoring System" or "T308+ Epoxy Adhesive Injection System" by Powers Fasteners.
- b. Non-structural adhesive anchors systems shall be IBC compliant and capable of resisting short term wind and seismic (Seismic Design Categories A and B) as well as long term and short term sustained static loads in uncracked concrete.
- c. Non-structural adhesive anchor embedment depth of the rod shall provide a minimum allowable bond strength that is equal to the allowable yield capacity of the rod unless noted otherwise on the Drawings.
- d. **No or equal products will be considered unless prequalified and approved by the Engineer and Owner.**

E. Concrete Anchor Rod Materials:

1. Concrete anchors used to anchor structural steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system, but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.
2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater concrete anchors shall be Type 316 stainless steel.
3. Nuts, washers, and other hardware shall be of a material to match the anchors.

2.04 WELDS

- A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).
- B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.
- C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.05 EYEBOLTS

- A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.06 ANTISEIZE LUBRICANT

- A. Antiseize lubricant shall be C5-A Anti-Seize by Loctite Corporation, Molykote P-37 Anti-Seize Paste by Dow Corning, 3M Anti-Seize by 3M, or equal.

PART 3 – EXECUTION

3.01 MEASUREMENTS

- A. The Contractor shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 ANCHOR INSTALLATION

- A. Anchor Rods, Concrete Anchors, and Masonry Anchors
  1. Anchor rods shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template. Overhead adhesive anchors, and base plates or elements they are anchoring, shall be shored as required and securely held in place during anchor

setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.

2. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.
3. Concrete anchors shall not be used in place of anchor rods without Engineer's approval.
4. All stainless steel threads shall be coated with antiseize lubricant.

B. Other Bolts

1. All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with a dielectric or approved equal.
2. All stainless steel bolts shall be coated with antiseize lubricant.

3.03 WELDING

- A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.
- B. Welded stud connectors shall be installed in accordance with AWS D1.1.

3.04 INSPECTION

- A. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.
- B. Post-installed concrete anchors shall be inspected as required by ACI 318.

3.05 CUTTING OF EMBEDDED REBAR

- A. The Contractor shall not cut embedded rebar cast into structural concrete during installation of post-installed fasteners without prior approval of the Engineer.

- - END OF SECTION - -



## SECTION 05531

### ACCESS DOORS

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all gratings, floor plates, and hatches in accordance with the Contract Documents.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 - Metal Materials
- B. Section 05050 - Metal Fastening

##### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
  - 1. North Carolina Building Code
  - 2. Aluminum Association Specifications for Aluminum Structures
  - 3. Occupational Safety and Health Administration (OSHA) Regulations

##### 1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
  - 1. Complete fabrication and erection Drawings of all gratings, access hatches, and access doors specified herein.
  - 2. Other submittals as required in accordance with Section 05010, Metal Materials, and Section 05050, Metal Fastening.

#### PART 2 – PRODUCTS

##### 2.01 METAL MATERIALS

- A. Metal materials used for gratings, floor plates, and hatches shall conform to Section 05010, Metal Materials, unless noted otherwise.

## 2.02 METAL FASTENING

- A. All welds and fasteners used for gratings, floor plates, and hatches shall conform to Section 05050, Metal Fastening, unless noted otherwise.

## 2.03 ACCESS DOORS

### A. General

1. Door opening sizes, number and direction of swing of door leaves, and locations shall be as shown on the Drawings. The Drawings shall indicate the clear opening dimensions.
2. All doors shall be aluminum unless otherwise noted.
3. Openings larger than 42 inches in either direction shall have double leaf doors.
4. Doors shall be designed for flush mounting and for easy opening from both inside and outside.
5. All doors shall be provided with an automatic hold-open arm with release handle.
6. Double leaf doors shall be provided with safety bars to go across the open sides of the door, when in the open position. Brackets shall be provided on the underside of the doors to hold the safety bars when not in use.
7. All hardware, including but not limited to, all parts of the latch and lifting mechanism assemblies, hold open arms and guides, brackets, hinges, springs, pins, and fasteners shall be stainless steel.
8. All doors shall be watertight with a continuous gasket. All single door applications shall include a continuous EPDM odor reduction gasket.
9. Door frames shall be extruded and equipped with a 1-1/2 inch minimum drain pipe located by the manufacturer. The drain pipe shall be provided by the Contractor and shall extend to the nearest point of discharge acceptable to the Engineer.

### B. Floor, Wet Well and Dry Pit Access Doors

1. Door leaves shall be 1/4 inch, minimum, diamond pattern plate with an approved raised pattern, non-skid surface. Plate shall be stiffened as required to maintain allowable stress and deflection requirements. Stiffeners shall consist of angles or bars welded to the bottom of plate.
2. Doors shall be designed for a 300 psf live load minimum, unless noted otherwise.
3. Doors shall be designed for flush mounting and for easy opening from both inside and outside.
4. All doors shall have an enclosed compression spring assist and open to 90 degrees.

5. Exterior doors shall be Type "J-AL" or "JD-AL", by Bilco Company, Type "W1S" or "W2S" by Halliday Products Inc., Type "TPS" or "TPD", by U.S.F. Fabrication Inc., Type "THG" or "THG-D", by Thompson Fabricating LLC.
6. Interior doors shall be Type "K" or "KD", by Bilco Company, Type "S1S" or "S2S" by Halliday Products Inc., Type "APS300" or "APD300", by U.S.F. Fabrication Inc., Type "TH" or "TH-D", by Thompson Fabricating LLC.
7. Doors rated for H-20 traffic loading shall be "JAL-HD" or "JDAL-HD" by the Bilco Company, Type "H1C" or "H2C" by Halliday Products, Inc., or Type "THS" or "THD" by U.S.F. Fabrication Inc.

## 2.04 FALL THROUGH PREVENTION SYSTEM

- A. All access hatches and access doors covering openings measuring 12 inches or more in its least dimension through which persons may fall shall be equipped with a fall through prevention system, except where noted on the Contract Drawings. Access hatches and access doors shall be provided with a permanent installed fall through prevention grate system that provides continuous safety assurance in both its closed and open positions. The grate system shall be made with 6061-T6 aluminum or FRP and be designed for a 300 psf minimum liveload, unless noted otherwise.

## PART 3 – EXECUTION

### 3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.
- B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.
- C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.
- D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.
- E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.
- F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050, Metal Fastening. All fastenings shall be concealed where practicable.

### 3.02 INSTALLATION

- A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.
- B. Access doors shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions. Embedded support frames shall be set level and square.

- - END OF SECTION - -



## SECTION 05540

### CASTINGS

#### PART 1 – GENERAL

##### 1.01 REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all castings in accordance with the requirements of the Contract Documents.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02604 – Utility Structures
- B. Section 05010 - Metal Materials

##### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
  - 1. North Carolina Building Code - 2012

##### 1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
  - 1. Complete fabrication and erection drawings of all castings specified herein.
  - 2. Other submittals as required in accordance with Section 05010, Metal Materials, and Section 05050, Metal Fastening.

#### PART 2 – PRODUCTS

##### 2.01 METAL MATERIALS

- A. Metal materials used for castings shall conform to Section 05010, Metal Materials, unless noted otherwise.

##### 2.02 METAL FASTENING

- A. All welds and fasteners used for castings shall conform to Section 05050, Metal Fastening, unless noted otherwise.

## 2.03 IRON CASTINGS

- A. General - Iron Castings shall include, but not be limited to frames, covers, and grates for trench drains, catch basins, and inlets/.
  - 1. Castings shall be of gray iron of uniform quality, free from defects, smooth and well cleaned by shotblasting.
  - 2. Catalog numbers on the Drawings are provided only to show required types and configuration. All covers shall be cast with raised letters as designated on the Drawings.
  - 3. Castings shall be as manufactured by Dewey Brothers, or Neenah Foundry Company.
- B. Covers and Grates
  - 1. Covers and grates shall be provided with matching frames. Cover shall fit flush with the surrounding finished surface. The cover shall not rock or rattle when loading is applied.
  - 2. Round covers and frames shall have machined bearing surfaces.
  - 3. Design loadings:
    - a. Where located within a structure, a minimum design loading of 300 psf shall be used, unless noted otherwise.
    - b. At all locations not within a structure, the design loading shall be a standard AASHTO H-20 truck loading, unless otherwise noted.
- C. Watertight gasketing, bolting, locking devices, patterns, lettering, pickholes, vents, or self-sealing features shall be as detailed on the Drawings.

## PART 3 – EXECUTION

### 3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.
- B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.
- C. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

### 3.02 INSTALLATION

- A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

- B. All castings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

- - END OF SECTION - -



## SECTION 09900

### PAINTING

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and Specified herein.
- B. Section Includes:
  - 1. Paint Materials
  - 2. Shop Painting
  - 3. Field Painting
    - a. Surface Preparation
    - b. Piping and Equipment Identification
    - c. Schedule of Colors
    - d. Work in Confined Spaces
    - e. OSHA Safety Colors

##### 1.02 RELATED SECTIONS

- A. Section 15030 - Piping and Equipment Identification Systems

##### 1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of these specifications the Work shall conform to the applicable requirements of the following documents:
  - 1. SSPC – The Society for Protective Coatings Standards
    - a. SSPC-Vis 1 Pictorial Surface Preparation Standards for Painting Steel Structures
    - b. SSPC-SP2 Hand Tool Cleaning
    - c. SSPC-SP3 Power Tool Cleaning
    - d. SSPC-SP5 White Metal Blast Cleaning
    - e. SSPC-SP6 Commercial Blast Cleaning

- f. SSPC-SP10Near-White Metal Blast
- g. SSPC-SP13/NACE6Surface Preparation of Concrete
- 2. NACE -National Association of Corrosion Engineers
- 3. ASTM D1737-Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus
- 4. ASTM B117-Method of Salt Spray (Fog) Testing
- 5. ASTM D4060-Test Method for Abrasion Resistance of Organic Coating by the Taber Abraser
- 6. ASTM D3359-Method for Measuring Adhesion by Tape Test

#### 1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:
  - 1. Manufacturer's literature and Material Safety Data Sheets for each product.
  - 2. Painting schedule identifying surface preparation and paint systems proposed. Cross reference with Tables 9 1 and 9 2. Provide the name of the paint manufacturer, and name, address, and telephone number of manufacturer's representative who will inspect the work. Submit schedule for approval as soon as possible following the Award of Contract, so approved schedule may be used to identify colors and specify shop paint systems for fabricated items.

#### 1.05 SYSTEM DESCRIPTION

- A. Work shall include surface preparation, paint application, inspection of painted surfaces and corrective action required, protection of adjacent surfaces, cleanup and appurtenant work required for the proper painting of all surfaces to be painted. Surfaces to be painted are designated within the Painting Schedule and may include new and existing piping, miscellaneous metals, equipment, buildings, exterior fiberglass, exposed electrical conduit and appurtenance.
- B. Perform Work in strict accordance with manufacturer's published recommendations and instructions, unless the Engineer stipulates that deviations will be for the benefit of the project.
- C. Paint surfaces which are customarily painted, whether indicated to be painted or not, with painting system applied to similar surfaces, areas and environments, and as approved by Engineer.
- D. Piping and equipment shall receive color coding and identification. Equipment shall be the same color as the piping system.

## 1.06 QUALITY ASSURANCE

- A. Painting operations shall be accomplished by skilled craftsman and licensed by the state to perform painting work.
- B. Provide a letter indicating that the painting applicator has five years of experience, and 5 references which show previously successful application of the specified or comparable painting systems. Include the name, address, and the telephone number for the Owner of each installation for which the painting applicator provided services.

## 1.07 STORAGE AND DELIVERY

- A. Bring materials to the job site in the original sealed and labeled containers.
- B. Container label to 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.
- C. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

## PART 2 – MATERIALS

### 2.01 GENERAL INFORMATION

- A. The term "paint" is defined as both paints and coatings including emulsions, enamels, stains, varnishes, sealers, and other coatings whether organic or inorganic and whether used as prime, intermediate, or finish coats.
- B. Purchase paint from an approved manufacturer. Manufacturer shall assign a representative to inspect application of their product both in the shop and field. The manufacturer's representative shall submit a report to the Engineer at the completion the Work identifying products used and verifying that surfaces were properly prepared, products were properly applied, and the paint systems were proper for the exposure and service.
- C. Provide primers and intermediate coats produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and only within manufacturer's recommended limits.
- D. Ensure compatibility of total paint system for each substrate. Test shop primed equipment delivered to the site for compatibility with final paint system. Provide an acceptable barrier coat or totally remove shop applied paint system when incompatible with system specified, and repaint with specified paint system.
- E. Use painting materials suitable for the intended use and recommended by paint manufacturer for the intended use.
- F. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each

product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

## 2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:
  - 1. Tnemec Company Inc.
  - 2. Ameron
  - 3. CARBOLINE
  - 4. Sherwin-Williams

## PART 3 – EXECUTION

### 3.01 SHOP PAINTING

- A. Shop prime fabricated steel and equipment with at least one shop coat of prime paint compatible with finish paint system specified. Prepare surface to be shop painted in strict accordance with paint manufacturer's recommendations and as specified. Finish coats may be shop applied, if approved by the Engineer. Package, store and protect shop painted items until they are incorporated into Work. Repair painted surfaces damaged during handling, transporting, storage, or installation to provide a painting system equal to the original painting received at the shop.
- B. Identify surface preparation and shop paints on Shop Drawings. Verify compatibility with field applied paints.

### 3.02 SURFACE PREPARATION

- A. General
  - 1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale, and foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless approved by the Engineer.
  - 2. Protect or remove, during painting operations, hardware, accessories, machined surfaces, nameplates, lighting fixtures, and similar items not intended to be painted prior to cleaning and painting. Reposition items removed upon completion of painting operations.
  - 3. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.



4. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where manufacturer recommends additional surface preparation, in addition to requirements of specification.
5. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the next coating. Touch up coats are in addition to the specified applied systems, and not considered a field coat.
6. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken.
7. Field paint shop painted equipment in compliance with Color Coding and as approved by Engineer.

B. Metal Surface Preparation

1. Conform to current The Society for Protective Coatings Standards (SSPC) Specifications for metal surface preparation. Use SSPC-Vis-1 pictorial standards or NACE visual standards TM-01-70 or TM-01-75 to determine cleanliness of abrasive blast cleaned steel.
2. Perform blast cleaning operations for metal when following conditions exist:
  - a. Moisture is not present on the surface.
  - b. Relative humidity is below 80%.
  - c. Ambient and surface temperatures are 5°F or greater than the dew point temperature.
  - d. Painting or drying of paint is not being performed in the area.
  - e. Equipment is in good operating condition.
  - f. Proper ventilation, illumination, and other safety procedures and equipment are being provided and followed.
3. Sandblast ferrous metals to be shop primed, or component mechanical equipment in accordance with SSPC-SP5, White Metal Blast.
4. Sandblast field prepared ferrous metals in accordance with SSPC-SP10, Near White Metal Blast, where metal is to be submerged, in a corrosive environment, or in severe service.
5. Sandblast field prepared ferrous metals in accordance with SSPC-SP6 Commercial Blast, where metal is to be used in mild or moderate service, or non-corrosive environment.

6. Clean nonferrous metals, copper, or galvanized metal surfaces in accordance to SSPC-SP1, Solvent Cleaning, or give one coat of metal passivator or metal conditioner compatible with the complete paint system.
7. Prime cleaned metals immediately after cleaning to prevent rusting.
8. Clean rusted metals down to bright metal by sandblasting and immediately field primed.

#### C. Concrete Surface Preparation

1. Cure concrete a minimum of 30 days before surface preparation, and painting begins.
2. Test concrete for moisture content using test method recommended by the paint manufacturer. Do not begin surface preparation, or painting until moisture content is acceptable to manufacturer.
3. Prepare concrete surfaces to receive coatings in accordance with SSPC-13 – Concrete Surface Preparation. Remove contaminants, open bugholes, surface voids, air pockets, and other subsurface irregularities. Do not expose underlying aggregate. Use dry, oil-free air for blasting operations. Surface texture after blasting shall be similar to that of medium grit sandpaper. Remove residual abrasives, dust, and loose particles by vacuuming or blowing with high pressure air.
4. Acid etch (Reference ASTM D 260) concrete floors to receive paint. Following method is a minimum requirement. Remove residual dust and dirt. Wet surface of concrete until surface is damp. Etch surface with 15% to 20% muriatic acid solution to produce a "medium sandpaper" texture. Do not allow acid solution to dry on concrete. Rinse concrete when bubbling action of the acid begins to subside. Continue rinsing process until pH is 7 or higher. Remove excess water and allow concrete to thoroughly dry before coating. Other methods may be used, if approved by Engineer.
5. Surface defects, such as hollow areas, bugholes, honeycombs, and voids shall be filled with polymeric filler compatible with painting system. Complete fill coats may be used in addition to specified painting system and as approved by the Engineer. Fins, form marks, and all protrusions or rough edges shall be removed.
6. Repair existing concrete surfaces which are deteriorated to the point that surface preparation exposes aggregate with fill coats or patching mortar as recommended by paint manufacturer and as directed by the Engineer.
7. Clean concrete of all dust, form oils, curing compounds, oil, tar, laitance, efflorescence, loose mortar, and other foreign materials before paints are applied.

#### D. Wood

1. Clean wood surfaces free of all foreign matter, with cracks and nail holes and other defects properly filled and smoothed. Remove sap and resin by scraping and wipe clean with rags dampened with mineral spirits.
2. Saturate end grain, cut wood, knots, and pitch pockets with an appropriate sealer before priming.
3. Prime and backprime wood trim before setting in place.

4. After prime coat has dried, fill nailholes, cracks, open joints, and other small holes with approved spackling putty. Lightly sand wood trim prior to applying second coat of paint.

#### E. Castings

1. Prepare castings for painting by applying a brush or a knife-applied filler. Fillers are not to be used to conceal cracks, gasholes, or excessive porosity.
2. Apply one coat of primer with a minimum thickness of 1.2 mils in addition to coats specified. Allow sufficient drying time before further handling.

#### F. Masonry

1. Cure for a minimum of 30 days prior to paint application.
2. Clean masonry surfaces free from all dust, dirt, oil, grease, loose mortar, chalky deposits, efflorescence, and other foreign materials.
3. Test masonry for moisture content. Use test method recommended by paint manufacturer. Do not begin painting until moisture content is acceptable to manufacturer.

#### G. Gypsum Drywall

1. Sand joint compound with sandpaper to provide a smooth flat surface. Avoid sanding of adjacent drywall paper.
2. Remove dust, dirt, and other contaminants.

#### H. Previously-Painted Surfaces

1. Totally remove existing paint when: surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.
2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.
3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.
4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.
5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

### 3.03 APPLICATION OF PAINT

- A. Apply paint by experienced painters with brushes or other applicators approved by the Engineer, and paint manufacturer.

- B. Apply paint without runs, sags, thin spots, or unacceptable marks.
- C. Apply at rate specified by the manufacturer to achieve at least the minimum dry mil thickness specified. Apply additional coats, if necessary, to obtain thickness.
- D. Special attention shall be given to nuts, bolts, edges, angles, flanges, etc., where insufficient film thicknesses are likely. Stripe paint prior to applying prime coat. Stripe painting shall be in addition to coats specified.
- E. Perform thinning in strict accordance with the manufacturer's instructions, and with the full knowledge and approval of the Engineer and paint manufacturer.
- F. Allow paint to dry a minimum of twenty four hours between application of any two coats of paint on a particular surface, unless shorter time periods are a requirement by the manufacturer. Longer drying times may be required for abnormal conditions as defined by the Engineer and paint manufacturer. Do not exceed manufacturer's recommended drying time between coats.
- G. Suspend painting when any of the following conditions exist:
  - 1. Rainy or excessively damp weather.
  - 2. Relative humidity exceeds 85%.
  - 3. General air temperature cannot be maintained at 50°F or above through the drying period, except on approval by the Engineer and paint manufacturer.
  - 4. Relative humidity will exceed 85% or air temperature will drop below 40°F within 18 hours after application of paint.
  - 5. Surface temperature of item is within 5 degrees of dewpoint.
  - 6. Dew or moisture condensation are anticipated.
  - 7. Surface temperature exceeds the manufacturer's recommendations.

### 3.04 INSPECTION

- A. Each field coat of paint will be inspected and approved by the Engineer or his authorized representative before succeeding coat is applied. Tint successive coats so that no two coats for a given surface are exactly the same color. Tick-mark surfaces to receive black paint in white between coats.
- B. Use magnetic dry film thickness gauges and wet film thickness gauges for quality control. Furnish magnetic dry film thickness gauge for use by the Engineer.
- C. Coatings shall pass a holiday detector test.
- D. Determination of Film Thickness: Randomly selected areas, each of at least 107.5 contiguous square feet, totaling at least 5% of the entire control area shall be tested. Within this area, at least 5 squares, each of 7.75 square inches, shall be randomly selected. Three readings shall be taken in each square, from which the mean film thickness shall be calculated. No more than 20 percent of the mean film thickness measurements shall be below the specified thickness. No single measurement shall be below 80 percent of the

specified film thickness. Total dry film thickness greater than twice the specified film thickness shall not be acceptable. Areas where the measured dry film thickness exceeds twice that specified shall be completely redone unless otherwise approved by the Engineer. When measured dry film thickness is less than that specified additional coats shall be applied as required.

- E. Holiday Testing: Holiday test painted ferrous metal surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Mark areas which contain holidays. Repair or repaint in accordance with paint manufacturer's printed instructions and retest.
  - 1. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
  - 2. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flow, shall be added to the water prior to wetting the detector sponge.
- F. Paint manufacturer or his representative shall provide their services as required by the Engineer. Services shall include, but not be limited to, inspecting existing paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work 11 months after the job is completed.

### 3.05 PROTECTION OF ADJACENT PAINT AND FINISHED SURFACES

- A. Use covers, masking tape, other method when protection is necessary, or requested by Owner or Engineer. Remove unwanted paint carefully without damage to finished paint or surface. If damage does occur, repair the entire surface adjacent to and including the damaged area without visible lapmarks and without additional cost to the Owner.
- B. Take all necessary precautions to contain dispersion of sandblasting debris and paint to the limits of the work. Take into account the effect of wind and other factors which may cause dispersion of the sandblasting debris and paint. Suspend painting operations when sanding debris or paint cannot be properly confined. Assume all responsibilities and cost associated with damage to adjacent structures, vehicles, or surfaces caused by the surface preparation and painting operations.

### 3.06 PIPING AND EQUIPMENT IDENTIFICATION

- A. Piping and equipment identification shall be in accordance with Section 15030, Piping and Equipment Identification Systems.

### 3.07 SCHEDULE OF COLORS

- A. Match colors indicated. Piping and equipment colors are indicated in Section 15030. Colors which are not indicated shall be selected from the manufacturer's full range of colors by the Engineer. No variation shall be made in colors without the Engineer's approval. Color

names and numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

### 3.08 WORK IN CONFINED SPACES

- A. Provide and maintain safe working conditions for all employees. Supply fresh air continuously to confined spaces through the combined use of existing openings, forced draft fans and temporary ducts to the outside, or direct air supply to individual workers. Exhaust paint fumes to the outside from the lowest level in the contained space. Provide explosion proof electrical fans, if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done. Follow OSHA, state and local regulations at all times.

### 3.09 OSHA SAFETY COLORS

- A. Paint wall around wall-mounted breathing or fire apparatus with the appropriate safety red color; area not exceed 2 feet wide by 3 feet high, unless apparatus covers the area. Fire apparatus include fire hoses, extinguisher, and hydrants.
- B. Paint hazardous areas and objects in accordance with OSHA regulations.

TABLE 9-1  
PAINTING SCHEDULE

SURFACE	APPLICATION	PAINTING SYSTEM & NO. OF COATS	PRODUCT REFERENCE (TABLE 9.2)	TOTAL MIN. DRY FILM THICKNESS (MILS)
<u>Concrete and Masonry</u>				
Interior masonry and concrete walls and ceilings	All new structures	1 coat sealer 2 coats acrylic epoxy	101 116	75-85 sq.ft./gal. 4-6/coat
Interior masonry and concrete walls in chemical rooms		1 coat sealer 2 coats epoxy polyamide	117 102	60-80 sq.ft./gal. 4-6/coat
Exterior masonry cavity walls on cavity face of inner wythe	All new structures	Dampproofing	See Section 07150	
Exterior below grade if interior is dry	Accessible areas (e.g. pipe galleries, pump rooms, basements, etc.)	Waterproofing	See Section 07100	
Submerged water	Water retaining side of new wall surfaces where opposite side of wall is interior and dry and where indicated "epoxy waterproofing" on drawing	2 coats NSF approved epoxy polyamide  Provide filler as required and recommended by manufacturer	105	4-6/coat
Submerged wastewater		2 coats high solids epoxy  Provide filler as required and recommended by manufacturer	119	6-10/coat
Containment Liner <sup>1</sup>	Interior and exterior secondary containment floors, tank supports and walls	2 coats high solids epoxy coating	119	6-10/coat

1. Painting manufacturer shall verify compatibility of containment liner and chemical to be contained. Where incompatible substitute a compatible coating system.

TABLE 9-1  
PAINTING SCHEDULE (CONTINUED)

SURFACE	APPLICATION	PAINTING SYSTEM & NO. OF COATS	PRODUCT REFERENCE (TABLE 9.2)	TOTAL MIN. DRY FILM THICKNESS (MILS)
<u>Metals</u>				
Interior and exterior nonsubmerged (gloss)	All new blowers, pumps, motors and mechanical equipment, piping, etc.	1 coat epoxy polyamide primer  1 coat epoxy polyamide 1 coat aliphatic polyurethane	104  102 115	4-6  4-6 3-5
Interior insulated		1 coat acrylic latex	103	4
Submerged water	All metal piping, and mechanical equipment, etc.	2 coats NSF approved epoxy polyamide	105	4-6/coat
Submerged Wastewater		2 coats high solids epoxy	119	8-10/coat
Steel doors, windows and door frames, steel stairs, monorails, structural steel, misc. metals (steel)		1 coat epoxy polyamide  1 coat aliphatic polyurethane	102  115	5-8  3-4
Aluminum surfaces in contact with concrete		2 coats coal tar	107	26
Shop Primed Structural Steel	Pre-Engineered Buildings	1 barrier coat 1 coat epoxy 1 coat epoxy	113 114 120	2-3 3-4 3-4
<u>Other</u>				
Interior: Gypsum Wallboard	All new structures	2 coats acrylic latex matte or satin	103	2-3/coat
Interior: Tar-dipped piping where color is required		2 coats epoxy resin sealer 2 coats epoxy polyamide	112  102	5-8/coat  5-8/coat
PVC Piping		1 coat epoxy polyamide 1 coat aliphatic polyurethane	102 115	5-8 3-4

TABLE 9-2

PRODUCT LISTING

REF.	SYSTEM	PURPOSE	PRODUCT			
			<u>Tnemec Series</u>	<u>PPG1 AMERON</u>	<u>CARBOLINE</u>	<u>Sherwin-Williams</u>
101	Acrylic filler	Primer-sealer	130-6601	BLOXFIL 4000	Sanitile 100	Cement-Plex 875
102	Epoxy polyamide	Finish coat semi-gloss or gloss	66	AMERLOCK 2/400	Carboguard 890	Macropoxy 646
103	Acrylic latex	Sealer	6	PITT TECH PLUS	Carbocrylic 3359DTM	DTM Acrylic Primer/Finish
104	Epoxy Polyamide – metal	Primer	66	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
105	Epoxy	Primer/Finish	20	AMERLOCK 2	Carboguard 561/56LT	Macropoxy 646 PW
106	Coal tar epoxy	Finish high-coat build	46H-413	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
107	Coal tar	Sealer	46-465	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
108	Alkyd-medium oil	Finish coat	2H	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
109	Alkyd-long oil	Finish coat	1029	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
110	Epoxy polyamide	Primer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
112	Epoxy polyamide	Sealer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 920 Pre-Prime
113	Urethane	Barrier coat	530	AMERLOCK SEALER	Rustbond	--
114	Polyamine Epoxy	Intermediate coat	27	AMERLOCK 385	Carboguard 893SG	--
115	Aliphatic Polyurethane	Finish coat	1074 or 1075	AMERCOAT 450 HS	Carbothane 134HG	Acrolon 218HS
116	Acrylic epoxy	Finish coat	113 or 114	AQUAPON WB	Sanitile 255	Water-Based Catalyzed Epoxy
117	Epoxy block filler	Sealer	54-562	AMERLOCK 400 BF	Sanitile 600	Cement Plex 875
118	Catalyzed epoxy	Finish coat	84	AMERLOCK 2/400	Carboguard 890	Macropoxy 646
119	High solids epoxy	Finish coat	104	AMERLOCK 400	Carboguard 890	Dura-Plate 235
120	Epoxy	Top coat	N69	AMERLOCK 2/400	Carboguard 890	--

- END OF SECTION -



SECTION 11000  
EQUIPMENT GENERAL PROVISIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in acceptable operation all mechanical equipment and all necessary accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.
- B. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, and other appurtenances as specified, and as may be required for a complete and operating installation.
- C. It is the intent of these Specifications that the Contractor shall provide the Owner complete and operational equipment/systems. To this end, it is the responsibility of the Contractor to coordinate all interfaces with related mechanical, structural, electrical, instrumentation and control work and to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as intended by the Specifications.
- D. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.
- E. The requirements of this section shall apply to equipment furnished under Divisions 11, 13, 14, and 15.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in Section 01090, Reference Standards.

1.03 SHOP DRAWINGS

- A. Shop Drawings shall be submitted to the Engineer for all equipment in accordance with Section 01300, Submittals and shall include the following information in addition to the requirements of Section 01300, Submittals:
  - 1. Performance characteristics and descriptive data.
  - 2. Detailed equipment dimensional drawings and setting plans.
  - 3. General lifting, erection, installation, and adjustment instructions, and recommendations.
  - 4. Complete information regarding location, type, size, and length of all field welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes and details.

5. The total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations. Exact size, placement, and embedment requirements of all anchor bolts.
6. Details on materials of construction of all components including applicable ASTM designations..
7. Information on bearing types and bearing life.
8. Gear box design and performance criteria and AGMA service factor.
9. Piping schematics.
10. Motor data sheet indicating motor horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor at  $\frac{1}{2}$ ,  $\frac{3}{4}$ , and full load; slip at full load; running, full load, and locked rotor current values; and safe running time-current curves.
11. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.
12. Equipment shop coating systems, interior and exterior.
13. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.
14. A list of spare parts and special tools to be provided.
15. Any additional information required to show conformance with the equipment specifications.
16. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.

#### 1.04 OPERATION AND MAINTENANCE INSTRUCTION/MANUALS

- A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01300, Submittals.
- B. O&M manuals shall include instructions, equipment ratings, technical bulletins, and any other printed matter such as wiring diagrams and schematics, prints or drawings, containing full information required for the proper operation, maintenance, and repair of the equipment. Included in this submission shall be a spare parts diagram, complete spare parts list, bill of materials, OEM part numbers and manufacturer's catalog information of all equipment components.
- C. Each set of instructions shall be bound together in appropriate three ring binders with a detailed Table of Contents..
- D. Written operation and maintenance instructions shall be required for all equipment items supplied for this project. The amount of detail shall be commensurate with the complexity of the equipment item.

- E. Information not applicable to the specific piece of equipment installed on this project shall be struck from the submission.
- F. Information provided shall include a source of replacement parts and names of service representatives, including address and telephone number.
- G. Extensive pictorial cuts of equipment are required for operator reference in servicing.
- H. When written instructions include Shop Drawings and other information previously reviewed by the Engineer, only those editions thereof which were approved by the Engineer, and which accurately depict the equipment installed, shall be incorporated in the instructions.

#### 1.05 GENERAL INFORMATION AND DESCRIPTION

- A. All parts of the equipment furnished shall, be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new, and both workmanship and materials shall be entirely suitable for the service to which the units are to be subjected and shall conform to all applicable sections of these Specifications.
- B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.
- C. Equipment and appurtenances shall be designed in conformity with ASTM, ASME, AIEE, NEMA, and other generally accepted applicable standards.
- D. All bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor elevation.
- E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.
- F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.
- G. All machinery and equipment shall be safeguarded in accordance with the safety codes of the USA and the State in which the project is located.
- H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with suitable protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.
- I. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.
- J. All manufactured items provided under this Section shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products. .

## 1.06 EQUIPMENT WARRANTIES

- A. Warranty requirements may be added to or modified in the individual equipment specifications.
- B. The equipment furnished under this Contract shall be guaranteed to be free from defects in workmanship, design and/or materials for a period of one (1) year unless otherwise specified in the individual equipment specifications. The period of such warranties shall start on the date the particular equipment is placed in use by the Owner with corresponding start-up certification provided by the manufacturer's technical representative as specified herein, provided that the equipment demonstrates satisfactory performance during the thirty day operational period after the equipment startup. If the equipment does not perform satisfactorily during the thirty day operational period, the start of the warranty period will be delayed until the equipment demonstrates proper operation. The Equipment Supplier shall repair or replace without charge to the Owner any part of equipment which is defective or showing undue wear within the guarantee period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory; furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified performance level.
- C. The Contractor shall provide an equipment warranty log book prepared specifically for this project and submit two (2) copies of the document to the Engineer prior to final payment. The equipment warranty log book shall include a summary listing of all equipment warranties provided, date received, and start date and end date of warranty period. A copy of each equipment warranty and equipment start-up certification shall also be provided in the document.
- D. The Equipment Supplier shall guarantee to the Owner that all equipment offered under these specifications, or that any process resulting from the use of such equipment in the manner stated is not the subject of patent litigation, and that he has not knowingly offered equipment, the installation or use of which is likely to result in a patent controversy, in which the Owner as user is likely to be made the defendant.

Where patent infringements are likely to occur, each Equipment Supplier shall submit, as a part of his bid, license arrangements between himself, or the manufacturer of the equipment offered, and the patent owner or the controller of the patent, which will permit the use in the specified manner of such mechanical equipment as he may be bidding.

Each Equipment Supplier, by submitting his bid, agrees to hold and save the Owner and Engineer or its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the work under this contract, including the use of the same by the Owner.

## PART 2 – PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. The materials covered by these Specifications are intended to be equipment of proven reliability, and as manufactured by reputable manufacturers having experience in the production of such equipment. The Contractor shall, upon request of the Engineer, furnish the names of not less than 5 successful installations of the manufacturer's equipment of the same size and model of that offered under this contract. The equipment furnished shall be

designed, constructed, and installed in accordance with the industry accepted practices and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

## 2.02 ANCHORS AND SUPPORTS

- A. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and suitable templates shall be used by the Contractor when required in the detailed equipment Specifications.
- B. Anchor bolts and fasteners shall be furnished in accordance with Section 05050, Metal Fastening, and with the individual equipment Specifications. All anchor bolts shall be a minimum of 1/2 inch diameter. All anchor bolts, handrail bolts, washers, clips, clamps, and fasteners of any type shall be constructed of 316 stainless steel, unless otherwise specified the individual equipment Specifications.
- C. The Contractor shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 6" high, unless otherwise shown on the Drawings and shall be doweled.
- D. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with non shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (such as shim leveling pumps, or chemical grout). Non shrink grout shall be as specified in Section 03600, Grout.

## 2.03 STRUCTURAL STEEL

- A. Structural steel used for fabricating equipment shall conform to the requirements of the Contract Documents.
- B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications.

## 2.04 DISSIMILAR METALS

- A. All dissimilar metals shall be properly isolated to the satisfaction of the Engineer.

## 2.05 GALVANIZING

- A. Where required by the equipment specifications, galvanizing shall be performed in accordance with the Contract Documents.

## 2.06 STANDARDIZATION OF GREASE FITTINGS

- A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be "Zerk" type.

## 2.07 ELECTRICAL REQUIREMENTS

- A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit and wiring, etc., specified in the equipment specifications shall comply with the applicable requirements of the Division 16 specifications and the latest National Electric Code.
- B. Motors shall conform to the applicable requirements of Section 15170, Electric Motors. Medium voltage motors shall conform to the applicable requirements of Section 15171, Medium Voltage Electric Motors.
- C. In the individual equipment specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.
- D. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between equipment supplier and VFD supplier to ensure a complete and operational system.
- E. Motor starters and controls shall be furnished and installed under Division 16 and Division 17 unless otherwise specified in the individual pump specifications.

## 2.08 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

- A. Spare parts for equipment shall be furnished where indicated in the equipment Specifications or where recommended by the equipment manufacturer.
- B. Spare parts shall be identical and interchangeable with original parts.
- C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- D. Painting requirements for spare parts shall be identical to those for original, installed parts. Where no painting or protective coating is specified, suitable provisions shall be made to protect against corrosion.
- E. Spare parts shall be delivered at the same time as the equipment to which they pertain. Spare parts shall be stored separately in a locked area, maintained by the Contractor, and shall be turned over to the Owner in a group prior to substantial completion. All of these materials shall be properly packed, labeled, and stored where directed by the Owner and Engineer.
- F. The Contractor shall furnish all special tools necessary to operate, disassemble, service, repair, and adjust the equipment in accordance with the manufacturers operation and maintenance manual.
- G. The Contractor shall furnish a one year supply of all recommended lubricating oils and greases. The manufacturer shall submit a list of at least four manufacturer's standard lubricants which may be used interchangeably for each type of lubricant required. All of these materials shall be properly packed, labeled and stored where directed by the Engineer.

## 2.09 EQUIPMENT IDENTIFICATION

- A. All mechanical equipment shall be provided with a substantial stainless steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.
- B. Each pump and other piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump #1". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.
- C. Nameplates shall not be painted over.

## PART 3 – EXECUTION

### 3.01 SHOP TESTING

- A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.
- B. No equipment shall be shipped to the project until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.
- C. Five (5) certified copies of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.
- D. If required by the individual equipment Specifications, arrangements shall be made for the Owner/Engineer to witness performance tests in the manufacturer's shop. The Engineer shall be notified ten working days before shop testing commences. Expenses are to be paid by Owner.
- E. Shop testing of electric motors shall be in accordance with applicable requirements of Section 15170, Electric Motors; Section 15171, Medium Voltage Electric Motors, and Section 16000, Basic Electrical Requirements.

### 3.02 STORAGE OF EQUIPMENT AND MATERIALS

- A. Contractor shall store his equipment and materials at the job site in strict accordance with the manufacturer's recommendations and as directed by the Owner or Engineer, and in conformity to applicable statutes, ordinances, regulations, and rulings of the public authority having jurisdiction. Equipment and materials shall not be delivered to the site prior to 90 days in advance of the scheduled installation. Partial payment requests will not be processed for materials delivered prior to 90 days before installation or for materials that are not properly stored.
- B. Material or equipment stored on the job site is stored at the Contractor's risk. Any damage sustained of whatever nature shall be repaired to the Engineer's satisfaction at no expense to the Owner. Stored electrical equipment is to be protected from the elements and shall have space heaters energized.

- C. Contractor shall not store unnecessary materials or equipment on the job site and shall take care to prevent any structure from being loaded with a weight which will endanger its security or the safety of persons.
- D. Contractor shall observe all regulatory signs for loadings on structures, fire safety, and smoking areas.
- E. Contractor shall not store materials or encroach upon private property without the written consent of the owners of such private property.

### 3.03 MANUFACTURER'S FIELD SERVICES

- A. The Contractor shall arrange for a qualified Technical Representative from each manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. When necessary, the Contractor shall schedule multiple Technical Representatives to be present at the same time for the purpose of coordinating the operation of multiple pieces of related equipment.
- B. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of his inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.
- C. The manufacturer's Technical Representative shall provide the following services.
  - 1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer's requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.
  - 2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.
  - 3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. In the event that equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to



the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

4. Training: The Technical Representative shall instruct the Owner's operating personnel in correct operation and maintenance procedures. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the Owner at least 2 weeks in advance of the training and shall be provided while the respective Technical Representative's equipment is fully operational. The Contractor shall have submitted, and had accepted, the O&M Manuals prior to commencement of training. Training shall be provided to three separate shifts of the Owner's personnel between the hours of 8:00 A.M. and 6:00 P.M. as necessary. The Contractor shall provide professional video taping of all training sessions. Completed, labeled tapes shall be provided to the Owner for each type of training session.
  5. Services after Startup: Where required by the individual equipment specifications, the Technical Representative shall return to the project site thirty (30) days after the start up date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, each manufacturer shall certify to the Owner in writing that his equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.
- D. Services of the Technical Representative will require a minimum of two (2) site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections.
  - E. The Contract amount shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.
  - F. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or Owner training session.
  - G. The Technical Representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day he is at the project.
- 3.04 INSTALLATION
- A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished the Engineer's field representative one week prior to installation.

- B. The Contractor shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory assembled insofar as practical.
- C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.
- D. All equipment sections and loose items shall be match-marked prior to shipping.
- E. For equipment such as pumping units, which require field alignment and connections, the Contractor shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the pump and motor prior to making piping connections or anchoring the pump base. Alignment shall be as specified herein.
- F. The Contractor shall furnish oil and grease for initial operation and testing. The manufacturer and grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.

### 3.05 ALIGNMENT

- A. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to  $\pm 1/16$  inch unless otherwise noted on the drawings. Wedges shall not be used for leveling, aligning, or supporting equipment.
- B. General Equipment Leveling: Non-rotating equipment shall be set level to  $\pm 1/16$  inch per 10 foot length (.005 inch per foot) unless otherwise noted on the drawings. Shims shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment baseplate edges. When grouting is required, equipment shall be shimmed to allow a minimum of one inch grout thickness. Grout shall cover shims at least 3 inches. Final level check shall be held for inspection and approval by Engineer before proceeding.
- C. Grouting
  - 1. Fill anchor bolt holes or sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.
  - 2. Surface Preparation. Roughen surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale. Saturate area with water at least 4 hours prior to grouting, removing excess water ponds.
  - 3. Application. Place grout after the equipment base has been set and its alignment and level have been approved. Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions. Eliminate all air or water pockets beneath the base using a drag chain or rope.
  - 4. Finishing. Point the edges of the grout to form a smooth 45 degree slope.
  - 5. After grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.

6. Level Verification. After grout has cured, and immediately prior to drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.
- D. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.
- E. Inspect and clean equipment mounting base pads, feet, and frames to remove all grease, rust, paint and dirt.
- F. Assembled equipment shafts shall be set level to .0015 inches per foot of shaft length (+/- .0005 inches) up to a maximum of 0.015 inches for any length shaft unless the manufacturers requirements are more stringent or unless otherwise noted in the equipment specifications. Use the machined surfaces on which the equipment sets for the base/mounting frame leveling plane. Use the machined shaft surface for equipment leveling plane.
- G. Sprocket and Sheave Alignment. Check shaft mounted components for face runout and eccentricity (outside diameter) runout by magnetically mounting a dial indicator on a stationary base and indicating over 360 degrees on a continuous machined surface at the outside diameter of the component. Maximum allowable total indicated face runout and eccentricity for sprockets and sheaves will be per ANSI Standard B29.1-1975.
- H. Belt tensioning. Set drive belt tension to manufacturer's specification for the belt type. Recheck alignment after drive tensioning.
- I. Thermal/Mechanical Growth. Thermal/mechanical growth corrections for driver and driven machines will be used in vertical and horizontal alignment where applicable. The equipment manufacturer will determine thermal/mechanical growth applicability for any machine and provide the correction offsets to be used.
- J. Rotating Shaft Alignment
  1. Fixtures will be set up on the driver and driven machine, machines shaft surfaces. Machined coupling hubs may be used only if there is no clearance to mount fixtures directly on the shafts.
  2. Primary alignment method for direct drive machines is when coupled. Uncoupled alignment will be used only when approved by the Engineer.
  3. Account for possible coupling flex by always rotating coupled machines in the same direction during alignment.
  4. Uncoupled machines must be connected so that both shafts turn together without relative motion during alignment.
  5. Indicator bar sag will be measured and included for each reverse indicator alignment setup.
  6. Reverse Dial Indicator. The final maximum allowable misalignment: vertical and horizontal from the desired targets of .000 inches (for a non-thermal growth machine) or from the given target readings (for a thermal growth machine) must meet BOTH of the following conditions simultaneously: 1/2 the final total indicator reading at each indicator

will be no more than shown in the table below AND the final remaining correction at each machine foot be no more than .001 inches of required movement.

Machine Speed (RPM)	Total Misalignment* (inches)
Up to 1800	.002
1800 and greater	.001

\* 1/2 indicator reading

### 3.06 FIELD TESTING

A. All equipment shall be set, aligned and assembled in conformance with the manufacturer's drawings and instructions. Provide all necessary calibrated instruments to execute performance tests. Submit report certified by the pump manufacturer's representative.

#### B. Preliminary Field Tests, Yellow Tag

1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall:
  - a. Verify that the equipment is free from defects.
  - b. Check for alignment as specified herein.
  - c. Check for direction of rotation.
  - d. Check motor for no load current draw.
2. Contractor shall flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.
3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or his assigned representative and attached to the equipment. The tag shall not be removed.
4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.

#### C. Final Field Tests, Blue Tag

1. Upon completion of the above, and at a time approved by the Engineer, the equipment will be tested by operating it as a unit with all related piping, ducting, electrical and controls, and other ancillary facilities.
2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his assigned representative and the Owner or his assigned representative.
3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration and noise. Operating field tests shall consist of the following:

- a. Check equipment for excessive vibration and noise as specified herein.
  - b. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded.
  - c. Recheck alignment with dial indicators where applicable, after unit has run under load for a minimum of 24 hours.
- D. In addition to the above described field tests, any other tests specifically required by Section 11100, Pumps-General, the individual equipment Specifications, or by the manufacturer shall be performed.
- E. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments and replacements at no additional cost to the Owner.
- F. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed and no further construction work will be performed on the unit, except as required during start up operations and directed by the Engineer.
- G. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
- H. All costs in connection with field testing of equipment such as lubricants, temporary instruments, labor, equipment, etc., shall be borne by the Contractor. Power, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied by the Owner unless otherwise specified in the individual equipment specifications.
- I. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.
- J. Field testing of electric motors shall be in accordance with Section 15170, Electric Motors; Section 15171, Medium Voltage Electric Motors, and Section 16000, Basic Electrical Requirements.

### 3.07 VIBRATION TESTING

- A. Unless specified otherwise in the detailed equipment specifications, each pump, blower, compressor, motor or similar item of stationary rotating equipment having a rated power in excess of 40HP shall be tested after installation for acceptable vibration levels.
- B. Vibration testing shall be performed by an experienced factory-trained and authorized third-party analysis expert (not a sales representative) retained by the Contractor and approved by the Engineer. Each unit or pump system shall be tested separately without duplicate equipment running. All field testing shall be done in the presence of the Engineer. The Engineer shall be furnished with four (4) certified copies of vibration test data for each test performed.
- C. For systems with variable speed drives, tests shall be conducted at various speeds between maximum and minimum. For systems with two-speed drives, tests shall be conducted at both speeds. For systems with constant-speed drive, tests shall be conducted under various loading conditions as determined by the Engineer.

- D. All field vibration tests shall be performed with the equipment operating on the product for which it is intended, or a substitute acceptable to the Engineer.
- E. The term displacement, as used herein, shall mean total peak-to-peak movement of vibrating equipment, in mils; velocity or speed of the vibration cycle, measured in G's. Displacement and velocity shall be measured by suitable equipment equal to IRD Mechanalysis, Bentley, Nevada.
- F. Frequency of vibration, in cycles per minute (cpm), shall be determined when vibration exceeds specified levels or as otherwise necessary. Vibration shall be measured on the bearing housing, unless other locations are deemed necessary by the vibration analysis expert and Engineer.
- G. For all equipment tested, vibration shall be checked in the radial and axial directions. Unless otherwise specified elsewhere, axial vibration shall not exceed 0.1 in/sec; and radial vibration shall not exceed 0.2 in/sec. For pumps radial vibration shall not exceed that permitted by the Hydraulic Institute Standards except that, at vibration frequencies in excess of 8,000 cpm, the velocity shall not exceed 0.2 in/sec.
- H. Copies of test results shall be submitted to the Engineer for review. Should the vibration field test results exceed shop test results, the manufacturer's recommendations, or the limits specified herein, the Contractor shall correct the deficiencies within thirty (30) days. After corrections have been completed, the vibration testing shall be re-run and the results re-submitted to the Engineer for review.
- I. Noise or vibration in any rotating equipment which the Engineer judges to be excessive or damaging, shall be cause for rejection.

### 3.08 FAILURE OF EQUIPMENT TO PERFORM

- A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor by replacements or otherwise.
- B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.
- C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.
- D. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.
- E. Upon receipt of said sums of money, the Owner will execute and deliver to the Contractor a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected.

- F. Said bill of sale shall not abrogate Owner's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

### 3.09 PAINTING

- A. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable sections of Section 09900, Painting.
- B. All shop coatings shall be compatible with proposed field coatings.
- C. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.
- D. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

### 3.10 WELDING

- A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- B. The Contractor's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- C. The Contractor shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

- - END OF SECTION - -





SECTION 11100  
PUMPS - GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and make fully operational all pumping equipment, complete with all necessary accessories, in compliance with the Contract Documents.
- B. All pumping equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.
- C. The provisions of this section shall apply to all pumps and pumping equipment specified except where specifically noted otherwise in the Contract Documents.
- D. The pumps shall be provided complete with all accessories, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.

1.02 SHOP DRAWINGS

- A. Shop Drawings shall include the following information in addition to the requirements of Section 01300, Submittals and Section 11000, Equipment General Provisions.
  - 1. Details of shaft sealing system
  - 2. Pump performance curves at rated speed and reduced speed (if reduced speeds are specified). Curves shall indicate flow, head, efficiency, brake horsepower, NPSH required, and minimum submergence. Curves shall include limits (minimum and maximum flows) for stable operation without cavitation, overheating, recirculation, or excessive vibration.
  - 3. General cutaway sections, materials, dimension of shaft projections, shaft and keyway dimensions, shaft diameter, dimension between bearings, general dimensions of pump, suction head bolt orientation, and anchor bolt locations and forces.
  - 4. Foundry certificates and results of Brinnell hardness testing showing compliance to ASTM A 532 (where required in the individual pump specifications).
  - 5. Submersible pump submittals shall also include:
    - a. Product data sheets for power and control cables and length of cables.
    - b. Details on pump guide rail system and mounting requirements.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

- A. All materials employed in the pumping equipment shall be suitable for the intended application. Material not specifically called for shall be high grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements unless otherwise specified in individual pumping equipment Specifications:
  - 1. Cast iron pump casings and bowls shall be of close grained gray cast iron, conforming to ASTM A 48, or equal.
  - 2. Bronze pump impellers shall conform to ASTM B 584, "G" bronze.
  - 3. Stainless steel pump shafts shall be of Type 400, Series. Miscellaneous stainless steel parts shall be of Type 316.
- B. Suction and discharge flanges shall conform to ANSI standard B16.1 or B16.5 dimensions.
- C. Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

### 2.02 APPURTENANCES

- A. Pressure Gauges
  - 1. The Contractor shall furnish and install pressure gauges on the suction and discharge of each pump, except wet-pit submersible pumps and vertical turbine pumps.
  - 2. The Contractor shall furnish and install pressure gauges on the discharge piping of each wet-pit submersible pump and vertical turbine pump in the locations shown on the Drawings or as directed by the Engineer.
  - 3. Suction gauges shall be of the single scale compound type to indicate both pressure and vacuum. Each suction gauge shall be graduated in feet of water over the span of 34 feet below and above zero.
  - 4. Discharge gauges shall be graduated in feet from zero to a minimum of five (5) feet of water above the respective pump shutoff head or to a minimum of 30% above the maximum operation pressure, whichever is greater. Graduation shall be in feet of water.
  - 5. All gauges shall be supplied by one manufacturer and shall be as specified in Section 17650, Pressure Gauges.
  - 6. All gauges shall be provided with diaphragm seals or isolating ring seals as specified in Section 17698, Instrumentation and Control Accessories.
- B. Flexible couplings for direct driven pumps shall be as manufactured by Falk, Dodge, Woods Corp., or equal and shall be furnished with guards in accordance with OSHA Rules and Regulations. Spacer couplings shall be provided where necessary to allow removal of the pump rotating element without disturbing the driver.

## 2.03 ELECTRICAL REQUIREMENTS

- A. All pumps shall be furnished with motors such that the motor shall not be overloaded throughout the full range of the pump operation, unless otherwise specifically approved by the Engineer.
- B. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between pump supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 16 and shall be as specified in Section 16495, Low Voltage Variable Frequency Drive Systems.
- C. Motor starters and controls shall be furnished and installed under Division 16 and Division 17 unless otherwise specified in the individual pump specifications.

## 2.04 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of Section 11000, Equipment General Provisions, nameplate data for each pump shall include the rating in gallons per minute, rated head, speed, and efficiency at the primary design point.

# PART 3 – EXECUTION

## 3.01 INSTALLATION

- A. Drains: All gland seals, air valves, and drains shall be piped to the nearest floor drain or trench drain with galvanized steel pipe or copper tube, properly supported with brackets.
- B. Solenoid Valves: Where required, the pump manufacturer shall furnish and install solenoid valves on the water or oil lubrication lines. Solenoid valve electrical rating shall be compatible with the motor control voltage and shall be furnished complete with all necessary conduit and wiring installation from control panel to solenoid.

## 3.02 SHOP TESTING

- A. Shop tests shall be performed in accordance with Section 11000, Equipment General Provisions, and except where stated otherwise herein, shall be conducted in accordance with the latest version of Hydraulic Institute Standard 14.6, Hydraulic Performance Acceptance Tests.
- B. Pump testing shall be witnessed by the Owner/Engineer where specified in the individual pump specifications. The testing procedure shall be submitted to the Engineer for review before scheduling the testing. The Engineer shall be given at least 2 weeks advanced notice of the scheduled testing date.
- C. Certified test curves shall be provided for all centrifugal pumps unless otherwise specified in the individual pump specifications. Certified tests will not be required for submersible sump pumps (as specified in Sections 11133 and 11136) with motors less than 5 hp.
- D. Pumps shall be within the tolerances specified for Acceptance Grade 1U, in accordance with the latest version of Hydraulic Institute Standards 14.6.

- E. For wet pit submersible pumps and vertical turbine pumps, all tests shall be run at minimum pump submergence specified in the individual pump specifications.
- F. Where required in the individual pump specifications, each individual casting shall be Brinnell tested in a minimum of two places, in an area of representative casting thickness to ASTM Method E 10. Results shall be certified by a registered professional ENGINEER. Test results shall verify the satisfaction of the required Brinnell hardness of the finished product as specified in respective subsections.

### 3.03 FIELD TESTING

- A. Field tests shall be performed in accordance with in Section 11000, Equipment General Provisions and additionally as specified below and in the individual pump specifications.
- B. Final acceptance tests shall demonstrate the following:
  - 1. The pumps have been properly installed and are in proper alignment.
  - 2. The pumps operate without overheating or overloading of any parts and without objectionable vibration. Vibration shall be within the Hydraulic Institute limits, or manufacturer's limits if more stringent.
  - 3. The pumps can meet the specified operating conditions. All pumps shall be checked at maximum speed for a minimum of four points on the pump curve for capacity, head, and amperage. The rated motor nameplate current shall not be exceeded at any point. Pumps with drive motors rated at less than five horsepower shall only be tested for overcurrent when overheating or other malfunction becomes evident in general testing.

- - END OF SECTION - -

## SECTION 11130

### SUBMERSIBLE NON-CLOG PUMPS

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install submersible non-clog pumps at the locations shown on the Drawings and as specified herein. All pumps shall be supplied by the same manufacturer.
- B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pump - General.

##### 1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

###### **McDonald Downs Pumps No. 1 – No. 2**

Number of Units		2	
Design Capacity (gpm)	150	290	400
Total Dynamic Head (feet)	52	41	30
Maximum Brake Horsepower	4	5	6
Maximum Pump Speed (rpm)		1750	
Temperature of Liquid Pumped		Ambient	
Suction Condition		Flooded	
Maximum Size of Solids (Spherical Diameter, Inches)		3	
Minimum Discharge Diameter (In.)		4	

##### 1.03 SUBMITTALS

- A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01300, Submittals; and Section 11000, Equipment General Provisions:
  - 1. Performance Affidavit

#### PART 2 – PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURERS

- A. Each pump shall be a submersible, non clog, centrifugal pump, as manufactured by Hydromatic or equal.

## 2.02 MATERIALS

- A. The pump and all related equipment shall be designed for the wastewater applications specified herein and shall be suitable for continuous or intermittent operation. The pump shall be bottom suction, side discharge construction and shall be supplied with a foot mounted discharge connection elbow and integral sliding rail removal system of the pump manufacturer's design matched to the pumps being supplied.
- B. The lifting cover, stator housing, and volute casing shall be close grained cast iron conforming to ASTM A48 Class 30, 35, or 40. Ductile iron pump volute shall be furnished if recommended by pump manufacturer for specified pressure rating. All exposed nuts, bolts, washers, and other fastening devices shall be AISI type 316 stainless steel.
- C. Casing shall be a smooth surface devoid of blowholes, pits, burrs, or other irregularities. The casing shall have a suction cover, which can be easily removed for easy access to the impeller. All non-stainless steel metal surfaces coming in contact with the pumped media shall be protected by a factory applied spray coating of Supplier's modified acrylic primer and finish. The volute shall be single piece, non concentric design and shall have smooth fluid passages large enough at all points to pass any size solids which can pass through the impeller. Pump volute shall be provided with a cleanout port to allow for removal of any foreign material blocking or impeding performance of the pump.
- D. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile or Viton rubber O rings. Fitting shall be such that sealing is accomplished by metal to metal contact between machined surfaces. This will result in controlled compression of the O rings without the requirement of a specific torque limit. Secondary sealing compounds, rectangular gaskets, elliptical O rings, grease or other devices shall not be acceptable.
- E. The impeller shall be hard alloy gray cast iron conforming to ASTM A-48 Class 30, 35, or 40. Impellers shall be dynamically balanced, closed non clogging design with multiple vanes. The impeller shall be capable of handling solids of specified sphere size, fibrous materials, heavy sludge, and other matter found in normal wastewater applications. The impeller shall be mechanically secured to the motor shaft per manufacturer's recommendations utilizing machined stainless steel components. Adhesive or friction-type fits are not acceptable. Impeller shall be coated with the same system applied to the interior of the casing.
- F. A wear ring system shall provide efficient sealing between the volute and impeller. Casing and impeller wear ring shall be of stainless steel construction. Supplier shall submit AISI grades of stainless steel proposed for the wear rings. Rings shall be drive fitted to the volute inlet and heat-shrink fitted to the impeller.
- G. Shafting shall be constructed of AISI 329 stainless steel or 400 Series stainless steel for the pump and motor, sufficiently large in diameter to transmit safely the maximum torque developed by the drive unit and of such a design as to provide a rigid support for the impeller and to prevent excessive vibration. The shaft shall be suitably heat treated, turned, ground, and polished over its entire length.
- H. Shaft Seals
  - 1. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies of high-pressure design. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at

a constant rate. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. Seal lubricant shall be FDA Approved, nontoxic.

2. The lower, primary seal unit, located between the pump and the lubricant chamber shall contain one stationary and one positively driven rotating, industrial duty, corrosion resistant, seal rings (Tungsten carbide/Tungsten carbide or Tungsten carbide/silicon carbide). The lower seal shall be independent of the impeller hub.
  3. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, chamber shall contain one stationary and one positively driven rotating, industrial duty, corrosion resistant, seal rings (ceramic/carbon or carbo/Ni-resist).
  4. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal. The seal system shall not be damaged when run dry. No external source of seal cooling or lubrication water shall be required.
  5. The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. Cartridge type systems will not be acceptable. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.
- I. The pump shaft shall rotate on at least two (2) heavy duty permanently lubricated bearings. Bearings shall be designed to carry all radial and axial thrust loads and shall have a minimum AFBMA B 10 life of 100,000 hours at all points along the usable portion of the pump curve at maximum pump speed.
  - J. Each pump, as specified herein or as recommended by the manufacturer, shall be provided with an integral, self-supplying cooling system that is adequately designed to cool the motor without an external cooling source. The cooling jacket shall be of cast-iron construction and shall surround the stator housing. The cooling jacket shall provide heat dissipation for the motor regardless of whether the motor unit is submerged in the pumped media or surrounded by air. The impeller back vanes shall provide the necessary circulation of the cooling liquid, a portion of the pumpage, through the cooling system. The cooling liquid shall pass through a classifying labyrinth prior to entering the cooling jacket. Two cooling liquid supply pipes, one discharging low and one discharging high within the jacket, shall direct the cooling liquid to the jacket. An air evacuation tube shall be provided to facilitate air removal from within the jacket. Any piping internal to the cooling system shall be shielded from the cooling media flow allowing for unobstructed circular flow within the jacket about the stator housing. Two cooling liquid return ports shall be provided. The internals to the cooling system shall be non-clogging by virtue of their dimensions. Drilled and threaded provisions for external cooling and, seal flushing or air relief are to be provided. The cooling jacket shall be equipped with two flanged, gasketed and bolted inspection ports of not less than 4" diameter located 180° apart. The cooling system shall provide for continuous submerged or completely non-submerged pump operation in liquid or in air having a temperature of up to 40°C (104°F), in accordance with NEMA standards. Restrictions limiting the ambient or liquid temperatures at levels less than 40°C are not acceptable.

- K. Gauge taps shall be provided on the discharge piping of the vertical submersible pumps in a location as directed by the Engineer. Gauge taps shall be threaded corporation stops, conforming to the requirements of Section 15000, Basic Mechanical Requirements. Gauges shall be as specified in Section 17650, Pressure Gauges.
- L. The Slide Rail Mounting System shall be as shown on the Contract Drawings and as specified herein.
1. A rail system shall be provided and installed for each pump. The pump shall be easily removed from the wetpit for inspection or service without entering the pit or disconnecting piping.
  2. The pump shall be provided with a foot mounted discharge connection elbow constructed of cast iron conforming to ASTM A48 Class 30 or 35, permanently installed in the wet well along with the discharge piping. The discharge connection elbow shall be constructed with a 125 lb. ANSI standard flat faced flange. The pump shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple downward motion of the pump.
  3. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pump unit shall be guided by the guide bar(s) and pressed tightly against the discharge connection elbow to provide positive sealing under all conditions.
  4. The entire sliding rail system shall be designed to safely withstand all stresses imposed thereon by vibration, torque, shock and all possible direct and eccentric loads. No portion of the pump shall bear directly on the floor of the sump.
  5. Lower guide bar holders shall be integral with the discharge connection. Guide bars shall be of at least standard weight 316 stainless steel pipe of a conservative size adequate for its intended use. The guide bars shall not support any portion of the weight of the pump.
  6. All anchor bolts, lifting bolts, eye lugs and lifting cable, etc. necessary for a complete installation and maintenance of the pump shall be constructed of Type 316 stainless steel and shall be adequately designed for its intended use.
  7. All metal to metal interfaces where movement might occur shall be non sparking. The slide mounting system for the influent pumps shall meet or exceed Underwriters Laboratory requirements for operation in a Class I, Division 1, Group D hazardous location.
- M. All anchor bolts, lifting bolts, eye lugs, etc. necessary for complete installation and maintenance of the pump shall be furnished by Supplier and constructed of Type 316 stainless steel and shall be adequately designed for its intended use.

## 2.03 ELECTRICAL AND CONTROL REQUIREMENTS

- A. The pump manufacturer shall provide the power and control cables between the pump and the local disconnect switch, junction box, or control panel (see Drawings) and shall be responsible for reviewing the electrical drawings as necessary to determine the required cable length. All pumps for the same pumping application shall be provided with the same



length of cable. No splices shall be allowed unless specifically indicated on the Drawings. Cables shall be PVC or oil resistant chloroprene rubber jacketed type SPC cable suitable for submersible pump applications, shall be sized according to NEC and ICEA standards, and shall meet with MSHA approval. Stainless steel strain relief connectors shall be furnished for all cables.

#### B. Cable Entry Water Seal

1. The cable entry water seal design shall insure a watertight and submersible seal without specific torque requirements. The cable entry shall be comprised of a single cylindrical elastomer grommet, flanked by stainless steel washers all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable. The assembly shall bear against a shoulder in the pump top. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate gaining access through the pump top. The junction chamber containing the terminal board shall be sealed from the motor by an elastomer compression seal O ring. Connection between the cable conductors and stator leads shall be made with threaded compressed type binding post permanently affixed to the terminal board and thus perfectly leak proof. Each pump shall be equipped with separate terminal board that totally isolates the incoming power supply from the pump motor.
2. An acceptable alternate cable entry seal shall include cable leads shall enter at the top of the motor and shall allow the cable-to-motor connection to be accomplished in the field without soldering. All power and control lead wires shall be double sealed as they enter the motor in such a manner that cable-wicking will not occur. This sealing system shall consist of a rubber grommet followed by epoxy that is high in adhesive qualities and has a low coefficient of expansion. Each conductor shall have a small section of insulation removed to establish a window area of bare wire and each wire shall be untwisted and surrounded by epoxy potting material. A cable strain relief mechanism shall be an integral part of the sealing system. The cable sealing system shall be capable of withstanding an external pressure test of 1,200 psi as well as a cable assembly pull test as required by Underwriters Laboratories. Power and control leads shall be terminated on a sealed terminal board. The terminal board and its bronze lugs shall be O-ring sealed.

#### C. Electrical Requirements

	<b>MacDonald Down Pumps No. 1 &amp; 2</b>
<b>Motors</b>	
Rating	460V, 3 ph, 60 Hz
Horsepower	7.5
Speed, rpm	1800
Insulation	Class F
Explosion Proof	Yes
Inverter Duty	No
Service Factor	1.15
Motor Winding Temperature Switches	Yes
RTDs	No
Cooling Jacket	No

- D. The pump motor shall be a squirrel cage induction type, housed in a watertight chamber. The stator winding and stator leads shall be moisture resistant. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing shall not be allowed.
- E. The motor shall be guaranteed for continuous unsubmerged duty, capable of sustaining a minimum of ten (10) starts per hour without overheating.
- F. The motor shall be provided with pre lubricated radial and thrust bearings which are designed to carry the entire load which may be imposed upon it under all operating conditions.
- G. All motors shall be of nationally known manufacture, shall be housed in enclosures specifically designed for submersible pump application.

#### 2.04 CONTROL PANEL

- A. Motor starters and controls for each duplex and triplex pump installation shall be provided in a stainless steel NEMA 4X control panel. The pump control panel shall be supplied by the pump manufacturer. Power and control cable between the pumps and the motor starters shall be furnished by the pump manufacturer. The pump control panel shall be as follows:
  - 1. The power circuit for each pump shall be fed from a dedicated circuit breaker within the panel. The circuit breaker shall be adequately sized for the motor loads and conductor sizes .
  - 2. A single lockable disconnect switch, operable from outside the control panel or mounted in a separate NEMA 4X stainless steel box, shall be provided for disconnecting power to the control panel.
  - 3. Each pump shall be provided with an across-the-line magnetic starter with all controls operating at 120V single phase.
  - 4. An H-O-A control switch shall be provided on the front of the control panel for each pump, in Auto, an ultrasonic level controller shall control the pumps. In Hand, the pump shall start immediately and run until the switch is placed in the 'off' position, or the low level float stops the pump.
  - 5. Auto shall also include automatic alternation of duty and standby pumps after each shutdown. Alternation shall occur upon all pumps off, and shall be in the following sequence:

Lead becomes Lag  
Lag becomes Standby  
Standby becomes Lead
  - 6. A control power transformer (CPT) shall be provided. The CPT shall be adequately sized to furnish all control power and other accessory loads that are required or specified.
  - 7. The panel shall have a 120V space heater and control thermostat to prevent moisture accumulation in the panel. The space heater shall be powered by the CPT.

8. A GFCI convenience receptacle, mounted outside of the enclosure in its own enclosure shall be powered by the mini power center.
9. Each pump shall have a six-digit elapsed time meter.
10. The control panel shall have individual alarm lights for each pump indicating, "moisture intrusion ", "motor overload, and "high temperature". These alarm conditions, except moisture intrusion, shall cause the pump to shut-down and prevent the pump from running so long as the alarm condition exists. Moisture intrusion shall be for alarm only. Additionally, there shall be a "low water level" and "high water level" alarm light, powered through auxiliary alarm contacts. The high and low level alarms shall be initiated by float switches. The alarm lights shall stay lit until the "reset" has been initiated, even if the condition has subsided, allowing for the pump to run. Intrinsically safe relays or barriers shall be provided in the control panel for safe operation of the float switches.
11. An indicator light shall be provided on the front of the panel that will illuminate if all the pumps in the station are on at any given time. The light shall stay illuminated until the "reset" is initiated.
12. An alarm strobe light shall be provided on top of each panel. The alarm strobe light shall be activated when any alarm condition exists.
13. Each panel shall include a minimum of 15 watt LED light and light switch inside the panel. The light shall be powered by the panel CPT.
14. High and low level float switches for each pump shall be provided by the pump manufacturer. The high level switch shall cause all the pumps in the station to start and run until the low level switch is tripped. Time delay relays shall be provided in the control panels to stagger the pumps when the high float switch is activated. The relays shall be set to provide five to ten second delays between pump starts.
15. All lights, switches, etc., on the panel shall be labeled per Section 16195.
16. Indicating lights and legend plates shall be provided for "control power on", "Pump No. 1 on", "Pump No. 2 on", "Pump No. 3 on" if applicable, and for "lag pump on".
17. Each panel shall include adjustable time delay relays to prevent simultaneous starting of pumps after a power outage.
18. Each control panel shall be provided with surge protection at 480V power supply to the panel and at the CPT 120V secondary. The main power supply suppressor shall be 3-phase surge protection device as manufactured by Joslyn or equal. The 120V single-phase suppressor shall be in accordance with the requirements specified in Section 17560.
19. Each panel shall bear NFPA and OSHA required warning labels.
20. All components in the control panel shall meet the requirements of Division 16 and Division 17.

## 2.05 SPARE PARTS

- A. Spare parts shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following for each series of pumps

- One (1) - set of lower and upper wearing rings
- One (1) - set of motor and pump bearings
- One (1) - complete mechanical seal assembly (upper and lower)
- Two (2) - complete set of gaskets and O-ring seals

### PART 3 – EXECUTION

#### 3.01 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions. For each series of pumps, field services shall include the following site visits:

<b>Service</b>	<b>Number of Trips</b>	<b>Number of Days/Trip</b>
Startup and Training	1	1

#### 3.02 SHOP TESTING

- A. Shop testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements:
1. Impeller, motor rating and electrical connections shall be checked.
  2. A motor and cable insulation test for moisture content or defective insulation shall be made.
  3. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
  4. The pump shall be run for 30 minutes submerged, a minimum of six (6) ft. under water.
  5. After the run-dry test, the insulation test shall be performed again.
  6. After the run-dry test, the pump shall be run continuously unsubmerged for 2 hours under full load with no damage to the motor. During this test, the pump shall demonstrate compliance with the specified performance for flow, head, and horsepower and shall experience a heat rise of not greater than 45°C (80°F) above ambient temperature.

- - END OF SECTION - -

## SECTION 15000

### BASIC MECHANICAL REQUIREMENTS

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install to the required line and grade, all piping together with all fittings and appurtenances, required for a complete installation. All piping located outside the face of structures or building foundations and all piping embedded in concrete within a structure or foundation shall be considered exterior piping.
- B. The Contractor shall furnish and install fittings, couplings, connections, sleeves, adapters, harness rods and closure pieces as required to connect pipelines of dissimilar materials and/or sizes herein included under this Section and other concurrent Contracts for a complete installation.
- C. The Contractor shall furnish all labor, materials, equipment, tools, and services required for the furnishing, installation and testing of all piping as shown on the Drawings, specified in this Section and required for the Work. Piping shall be furnished and installed of the material, sizes, classes, and at the locations shown on the Drawings and/or designated in this Section. Piping shall include all fittings, adapter pieces, couplings, closure pieces, harnessing rods, hardware, bolts, gaskets, wall sleeves, wall pipes, hangers, supports, and other associated appurtenances for required connections to equipment, valves, or structures for a complete installation.
- D. Piping assemblies under 4 inch size shall be generally supported on walls and ceilings, unless otherwise shown on the Drawings or ordered by the Engineer, being kept clear of openings and positioned above "headroom" space. Where practical, such piping shall be run in neat clusters, plumb and level along walls, and parallel to overhead beams.
- E. The Contractor shall provide taps on piping where required or shown on the Drawings. Where pipe or fitting wall thicknesses are insufficient to provide the required number of threads, a boss or pipe saddle shall be installed.
- F. The work shall include, but not be limited to, the following:
  - 1. Connections to existing pipelines.
  - 2. Test excavations necessary to locate or verify existing pipe and appurtenances.
  - 3. Installation of all new pipe and materials required for a complete installation.
  - 4. Cleaning, testing and disinfecting as required.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 1, General Requirements

- B. Division 2, Sitework
- C. Division 9, Finishes
- D. Division 11, Equipment
- E. Division 16, Electrical

#### 1.03 MATERIAL CERTIFICATION AND SHOP DRAWINGS

- A. The Contractor shall furnish to the OWNER (through the Engineer) a Material Certification stating that the pipe materials and specials furnished under this Section conform to all applicable provisions of the corresponding Specifications. Specifically, the Certification shall state compliance with the applicable standards (ASTM, AWWA, etc.) for fabrication and testing.
- B. Shop Drawings for major piping (2-inches in diameter and greater) shall be prepared and submitted in accordance with Section 01300 – Submittals. In addition to the requirements of Section 01300 – Submittals, the Contractor shall submit laying schedules and detailed Drawings in plan and profile for all piping as specified and shown on the Drawings.
- C. Shop Drawings shall include, but not be limited to, complete piping layout, pipe material, sizes, class, locations, necessary dimensions, elevations, supports, hanger details, pipe joints, and the details of fittings including methods of joint restraint. No fabrication or installation shall begin until Shop Drawings are approved by the Engineer.

### PART 2 – PRODUCTS

#### 2.01 GENERAL

- A. All specials and every length of pipe shall be marked with the manufacturer's name or trademark, size, class, and the date of manufacture. Special care in handling shall be exercised during delivery, distribution, and storage of pipe to avoid damage and unnecessary stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.
- B. Testing of pipe before installation shall be as described in the corresponding ASTM or AWWA Specifications and in the applicable standard specifications listed in the following sections. Testing after the pipe is installed shall be as specified in Section 3.09.
- C. Joints in piping shall be of the type as specified in the appropriate Piping System Schedule in Section 15390, Schedules.
- D. ALL BURIED EXTERIOR PIPING SHALL HAVE RESTRAINED JOINTS FOR THRUST PROTECTION UNLESS OTHERWISE SPECIFIED OR SHOWN ON THE DRAWINGS. ALL EXPOSED EXTERIOR PIPING SHALL HAVE FLANGED JOINTS, UNLESS OTHERWISE SPECIFIED OR SHOWN ON THE DRAWINGS.
- E. The Drawings indicate work affecting existing piping and appurtenances. The Contractor shall excavate test pits as required of all connections and crossings which may affect the Contractor's work prior to ordering pipe and fittings to determine sufficient information for

ordering materials. The Contractor shall take whatever measurements that are required to complete the work as shown or specified.

## 2.02 WALL PIPES

- A. Where wall sleeves or wall pipes occur in walls that are continuously wet on one or both sides, they shall have water stop flanges at the center of the casting or as shown on the Drawings. Ends of wall pipes shall be flange, mechanical joint, plain end, or bell as shown on the Drawings, or as required for connection to the piping. Wall pipes shall be of the same material as the piping that they are connected to. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange. Unless otherwise shown on the Drawings, waterstop flanges shall conform to the minimum dimensions shown below:

<u>Pipe Size</u>	<u>Waterstop Flange Diameter</u>	<u>Waterstop Flange Thickness</u>
4" - 12"	OD + 3.10"	0.50"
14" - 24"	OD + 4.15"	0.75"
30" - 36"	OD + 4.50"	1.00"
42" - 48"	OD + 5.00"	1.25"
54"	OD + 5.90"	1.50"

## 2.03 SLEEVES

- A. Unless shown otherwise, all piping passing through walls and floors shall be installed in sleeves or wall castings accurately located before concrete is poured, or placed in position during construction of masonry walls. Sleeves passing through floors shall extend from the bottom of the floor to a point 3 inches above the finished floor, unless shown otherwise. Water stop flanges are required on all sleeves located in floors or walls which are continually wet or under hydrostatic pressure on one or both sides of the floor or wall.
- B. Sleeves shall be cast iron, black steel pipe, or fabricated steel in accordance with details shown on the Drawings. If not shown on the Drawings, the Contractor shall submit to the Engineer the details of sleeves he proposes to install; and no fabrication or installation thereof shall take place until the Engineer's approval is obtained. Steel sleeves shall be fabricated of structural steel plate in accordance with the standards and procedures of AISC and AWS. Steel sleeve surfaces shall receive a commercial sandblast cleaning and then be shop painted in accordance with Section 09900 – Painting.
- C. When shown on the Drawings or otherwise required, the annular space between the installed piping and sleeve shall be completely sealed against a maximum hydrostatic pressure of 20 psig. Seals shall be mechanically interlocked, solid rubber links, trade name "Link Seal", as manufactured by the Thunderline Corp., Wayne, Michigan, or equal. Rubber link, seal type, size, and installation thereof, shall be in strict accordance with the manufacturer's recommendations. For non-fire rated walls and floors, pressure plate shall be glass reinforced nylon plastic with EPDM rubber seal and 304 stainless steel bolts and nuts. For fire rated walls and floors, two independent seals shall be provided consisting of low carbon steel, zinc galvanized pressure plates, silicon rubber seals and low carbon steel, zinc galvanized bolts and nuts.

- D. Cast iron mechanical joint adapter sleeves shall be Clow # 1429, as manufactured by the Clow Corp., or equal. Mechanical joint adapter sleeves shall be provided with suitable gasket, follower ring, and bolts to effect a proper seal. In general, sleeves installed in walls, floors, or roofs against one side of which will develop a hydrostatic pressure, or through which leakage of liquid will occur, shall be so sealed. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange.

#### 2.04 SOLID SLEEVE COUPLINGS

- A. Solid sleeve couplings shall be used to connect buried service piping where shown on the Drawings. Solid sleeves shall be ductile iron, long body and shall conform to the requirements of ANSI A21.10 (AWWA C110). Unless otherwise shown or specified, solid sleeve couplings shall be Style A11760 as manufactured by American Cast Iron Pipe Co., or equal.

#### 2.05 FLEXIBLE COUPLINGS

- A. Flexible couplings shall be as manufactured by the Red Valve Company and shall consist of a molded reinforced fabric of cotton and natural rubber. Galvanized steel retaining rings shall be furnished. End connections shall match ANSI 125 pound flanges with a minimum pressure rating of 140 psi.

#### 2.06 SLEEVE TYPE COUPLINGS

- A. Sleeve type, flexible couplings shall be furnished and installed where shown on the Drawings or otherwise required to resist internal operating pressures. In addition to that specified herein, harnessed, sleeve type flexible couplings shall be provided on all exposed pipe 3 inches and larger in diameter that spans any expansion joint in a building or structure.
- B. Materials shall be of high strength steel and couplings shall be rated for the same pressures as the connecting piping.
- C. Gaskets shall be rubber. Bolts and nuts shall be alloy steel, corrosion resistant and prime coated.
- D. Couplings shall be shop primed with a premium quality primer compatible with the painting system specified in Section 09900 - Painting. Field painting of wetted area shall be done prior to installation.
- E. Harnessing
  - 1. Harness couplings to adjacent flanges as shown, specified or otherwise required to restrain all pressure piping.
  - 2. Dimensions, sizes, spacing and materials for lugs, tie rods, washers, and nuts shall conform to the standards for the pipe size, and design pressure specified.
  - 3. No less than two (2) bolts shall be furnished for each coupling.
  - 4. Tie bolts, nuts and washers shall be ASTM A 193, Grade B7 steel or better.
  - 5. Harness rods shall have lengths less than 10 feet between adjacent flanged joints on fittings and shall be coated in accordance with Section 09900 – Painting.



- F. Couplings shall be as manufactured by Dresser Industries, Style 38, or equal as required and shown on the Drawings. All couplings shall be provided without interior pipe stop.

## 2.07 FLANGED ADAPTERS

- A. Flanged adapters shall be furnished as required and as shown on the Drawings.
- B. All flanged adapters, 12 inches in diameter and smaller, except as shown on the Drawings or directed by the Engineer, shall be locking type flanged adapters.
- C. Pressure and service shall be the same as connected piping.
- D. Materials shall be cast iron for pipes up to 12 inch diameter and high strength steel for pipes larger than 12 inch diameter.
- E. Flanged adapters shall be shop primed with a premium quality primer compatible with the paint system specified in Section 09900 – Painting. Field painting of wetted area shall be done prior to installation.
- F. Bolts and nuts shall be alloy steel, corrosion resistant and prime coated.
- G. Flanged coupling adapters larger than 12 inches in diameter shall be harnessed by tying the adapter to the nearest pipe joint flange using threaded rods and rod tabs. The threaded rods and rod tabs shall be as shown on the Drawings.
- H. Flanged adapters shall be as manufactured by Dresser Industries, Style 127 or 128, Smith Blair Corporation, or equal.

## 2.08 MECHANICAL COUPLINGS (SPLIT TYPE - SHOULDERED END)

- A. Mechanical couplings (split type-shouldered end) shall be furnished as specified or shown on the Drawings.
- B. Materials shall be of malleable iron and couplings shall be rated for the same pressures as the connecting piping.
- C. Gaskets shall be rubber. Bolts and nuts shall be heat treated carbon steel track bolts and shall be plated.
- D. After installation, buried couplings shall receive two heavy coats of an approved coal tar which is compatible with the finish of the coupling. Exposed couplings shall be painted in accordance with Section 09900 - Painting.
- E. Couplings shall be as manufactured by Victaulic Company of America, Style 44, or equal.

## 2.09 TAPPING SLEEVES AND TAPPING SADDLES

- A. Tapping sleeves shall be similar to Mueller Outlet Seal, American Uniseal or Kennedy Square Seal. All sleeves shall have a minimum working pressure of 150 psi. All sleeves larger than twelve (12) inches shall be ductile iron. All taps shall be machine drilled; no burned taps will be allowed.

- B. Tapping saddles may be used on mains sixteen (16) inches and larger where the required tap size does not exceed one half the size of the main (i.e. 8 inch tapping saddle for use on a 16 inch main). Tapping saddles shall be manufactured of ductile iron providing a factor of safety of at least 2.5 at a working pressure of 250 psi. Saddles shall be equipped with a standard AWWA C 110 77 flange connection on the branch. Sealing gaskets shall be "O" ring type, high quality molded rubber having an approximate seventy durometer hardness, placed into a groove on the curved surface of the tapping saddles. Straps shall be of alloy steel. The tapping saddle shall be the American tapping saddle, U.S. Pipe tapping saddle, or equal. All taps shall be machine cut, no burned taps will be allowed.

## 2.10 UNIONS

- A. For ductile iron, carbon steel, and grey cast iron pipes assembled with threaded joints and malleable iron fittings, unions shall conform to ANSI B16.39.
- B. For copper piping, unions shall have ground joints and conform to ANSI B16.18.
- C. For PVC and CPVC piping, unions shall be socket weld type with Viton O ring.

## 2.11 THERMOPLASTIC TUBING AND FITTINGS

- A. Thermoplastic tubing shall be manufactured from polyallomor tubing. Tubing shall be protected from ultraviolet radiation degradation with a black coating or integral color conforming to ASTM D 1248, Type 1, Class C, Category 3. Fittings and connectors used with thermoplastic tubing shall be the flareless tube type constructed of brass conforming to SAE CA377, SAE CA360 or equal. Brass sleeves shall be used.
- B. Assembly of the thermoplastic tubing shall consist of pushing the tubing into the fitting and hand tightening the nut with final tightening with a wrench. Care shall be taken not to overtighten the nut. Plastic tube racks and bend holders shall be provided for holding the tubing in position. Needle valves used with thermoplastic tubing shall be the globe type constructed with a brass body, stem and seat and Buna-N "O"-ring seals. Installation shall be in accordance with the manufacturer's recommendations. Thermoplastic tubing, shall be the Impolene (polyallomor) system and needle valves, fittings and connectors shall be the Poly Flo with 261 UB Universal Nut and Sleeve system as manufactured by Imperial Eastman, or equal.

## 2.12 HEAT TRACED PIPING

- A. Exposed pipes to be insulated shall also be protected from freezing by heat tracing. Freeze protection heat tracing shall consist of twin 16 AWG copper brass wires with a semiconductor polymer core where electrical resistance varies with temperature. The heat tracing shall have a fluoropolymer outer jacket for corrosion resistance. The heat tracing shall be rated for three (3) watts per foot output, self-regulating with a maximum temperature of 150°F, equal to a Chromalox No. SRL3 1CT383400. Maximum length for tape shall be 300 feet for each circuit. Temperature controller shall be provided to sense pipe temperature to determine on or off condition of the heat tracing. Temperature control shall be equal to a Chromalox No. RTBC 2 384729. The heat tracing system shall operate on 120 VAC. See Drawings for installation detail. Heat tracing of piping shall be provided as specified in Section 15390 – Schedules.

## 2.13 FLEXIBLE RESTRAINED EXPANSION JOINTS

- A. Restrained expansion joints shall be manufactured of 60-42-10 ductile iron conforming to material and other applicable requirements of ANSI/AWWA C153/A21.53.
- B. Each pressure containing component shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the materials requirements of, and tested in accordance with, ANSI/AWWA C213 and shall meet or exceed the requirements of ANSI/AWWA C550.
- C. Seals shall conform to the applicable requirements of ANSI/AWWA C111/A21.11.
- D. All bolts used in the assemblies shall be stainless steel and shall be coated with a premium quality epoxy.
- E. Flanged ends shall comply with ANSI/AWWA C110/A21.10, with the addition of O-ring groove and O-ring.
- F. Mechanical joint ends shall comply with ANSI/AWWA C153/A21.53.
- G. Restrained expansion joints shall have a minimum pressure rating of 350 psi with a minimum safety factor of 3:1. Each assembly shall be tested at 350 psi before shipment.
- H. Restrained expansion joints shall provide for self restraint without tie rods and shall provide for expansion and contraction capabilities cast as an integral part of the end connection.
- I. Flexible restrained expansion joints shall allow for 8-inches (+6"-2") minimum expansion.
- J. Flexible restrained expansion joints shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint having a minimum of 15° deflection per ball.
- K. Restrained expansion joints shall be the Single Ball or Double Ball FLEX-TEND Expansion Joint as manufactured by EBAA Iron Inc., or equal.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

- A. All piping shall be installed by skilled workmen and in accordance with the best standard practice for piping installation as shown on the Drawings, specified or recommended by the pipe manufacturer. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used. Great care shall be taken to prevent any pipe coating from being damaged on the inside or outside of the pipe and fittings. All pieces shall be carefully examined for defects, and no piece shall be installed which is known to be cracked, damaged, or otherwise defective. If any defective pieces should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his own expense. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work. All piping connections to equipment shall be provided with unions or coupling flanges located so that piping may be readily dismantled from the equipment. At certain applications, Dresser, Victaulic, or equal, couplings may also be used. All piping shall be installed in such a manner that it will be free to expand and contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to

accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Unless otherwise shown or approved, provided a minimum headroom clearance under all piping of 7 feet 6 inches.

- B. Unless otherwise shown or specified, all waste and vent piping shall pitch uniformly at a 1/4 inch per foot grade and accessible cleanouts shall be furnished and installed as shown and as required by local building codes. Installed length of waste and vent piping shall be determined from field measurements in lieu of the Drawings.
- C. All excavation shall be made in such a manner and to such widths as will provide ample room for properly installing the pipe and permit thorough compaction of backfill around the pipe. The minimum trench widths shall be in strict accordance with the "Trench Width Excavation Limits" as shown on the Drawings. All excavation and trenching shall be done in strict accordance with these specifications and all applicable parts of the OSHA Regulations, 29CFR 1926, Subpart P.
- D. ALL EXCAVATION REQUIRED BY THIS CONTRACT SHALL BE UNCLASSIFIED. NO ADDITIONAL PAYMENT WILL BE MADE FOR ROCK EXCAVATION REQUIRED FOR THE INSTALLATION OF PIPE OR STRUCTURES SHOWN ON THE DRAWINGS.
- E. Enlargements of the trench shall be made as needed to give ample space for operations at pipe joints. The width of the trench shall be limited to the maximum dimensions shown on the Drawings, except where a wider trench is needed for the installation of and work within sheeting and bracing. Except where otherwise specified, excavation slopes shall be flat enough to avoid slides which will cause disturbance of the subgrade, damage to adjacent areas, or endanger the lives or safety of persons in the vicinity.
- F. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, or obstructions.
- G. No greater length of trench in any location shall be left open, in advance of pipe laying, than shall be authorized or directed by the Engineer and, in general, such length shall be limited to approximately one hundred (100) feet. The Contractor shall excavate the trenches to the full depth, width and grade indicated on the Drawings including the relevant requirements for bedding. The trench bottoms shall then be examined by the Engineer as to the condition and bearing value before any pipe is laid or bedding is placed.
- H. No pressure testing shall be performed until the pipe has been properly backfilled in place. All pipe passing through walls and/or floors shall be provided with wall pipes or sleeves in accordance with the specifications and the details shown on the Drawings. All wall pipes shall be of ductile iron and shall have a water stop located in the center of the wall. Each wall pipe shall be of the same class, thickness, and interior coating as the piping to which it is joined. All buried wall pipes shall have a coal tar outside coating on exposed surfaces.
- I. JOINT DEFLECTION SHALL NOT EXCEED 75 PERCENT OF THE MANUFACTURERS RECOMMENDED DEFLECTION. Excavation and backfilling shall conform to the requirements of Section 02200 - Earthwork, and as specified herein. Maximum trench widths shall conform to the Trench Width Excavation Limits shown on the Drawings. All exposed, submerged, and buried piping shall be adequately supported and braced by means of hangers, concrete piers, pipe supports, or otherwise as may be required by the location.

- J. Following proper preparation of the trench subgrade, pipe and fittings shall be carefully lowered into the trench so as to prevent dirt and other foreign substances from gaining entrance into the pipe and fittings. Proper facilities shall be provided for lowering sections of pipe into trenches. UNDER NO CIRCUMSTANCES SHALL ANY OF THE MATERIALS BE DROPPED OR DUMPED INTO THE TRENCH.
- K. Water shall be kept out of the trench until jointing and backfilling are completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no water, earth, or other substance will enter the pipes, fitting, or valves. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored as required.
- L. All piping shall be installed in such a manner that it will be free to expand and/or contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Pipes crossing within a vertical distance of less than or equal to one (1) foot shall be encased and supported with concrete at the point of crossing to prevent damage to the adjacent pipes as shown on the Drawings.
- M. The full length of each section of pipe shall rest solidly upon the bed of the trench, with recesses excavated to accommodate bells, couplings, joints, and fittings. Before joints are made, each pipe shall be well bedded on a solid foundation; and no pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid by the Contractor at his own expense. Pipe shall not be laid in water or when trench conditions are unsuitable for work.
- N. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall in general agree with manufacturer's recommendations.
- O. AT THE CLOSE OF EACH WORK DAY THE END OF THE PIPELINE SHALL BE TIGHTLY SEALED WITH A CAP OR PLUG SO THAT NO WATER, DIRT, OR OTHER FOREIGN SUBSTANCE MAY ENTER THE PIPELINE, AND THIS PLUG SHALL BE KEPT IN PLACE UNTIL PIPE LAYING IS RESUMED.
- P. During the laying of pipe, each pipe manufacturer shall provide his own supervisor to instruct the Contractor's pipe laying personnel in the correct procedure to be followed.
- Q. Ordinarily only full lengths of pipe (as furnished by the pipe manufacturer) shall be used exceptions: closure pieces at manholes and areas where joint deflection is required.
- R. For gravity sewer installations, the Contractor shall use a laser device to maintain the trench and pipe alignment. The laser device shall be re-checked for correct elevation and pipe alignment prior to pipe installation if the device is left in the pipe overnight. Corrected invert elevations at each manhole and any adjustments will be coordinated and approved by the Engineer.
- S. ALL PIPING SHALL HAVE TYPE "A" BEDDING AS SHOWN ON THE DRAWINGS, UNLESS OTHERWISE SPECIFIED HEREIN OR INDICATED ON THE DRAWINGS.
- T. Detector tape shall be installed 12 inches below final grade and directly above all buried potable water piping. The tape shall be blue and silver and shall be clearly and permanently

labeled "Water". Detector tape shall be Lineguard III as manufactured by Lineguard, Inc., or equal.

- U. AT THE CLOSE OF WORK EACH DAY PIPELINE TRENCHES SHALL BE COMPLETELY BACKFILLED.

### 3.02 REINFORCED CONCRETE PIPE, CONCRETE CULVERT, AND DRAIN PIPE

- A. The laying of reinforced concrete pipe shall conform to the applicable sections of the Concrete Pipe Handbook as published by the American Concrete Pipe Association.

### 3.03 PRESTRESSED CONCRETE PIPE

- A. The laying of prestressed concrete pipe shall be in accordance with the manufacturer's recommendations and shall conform to the applicable sections of AWWA Manual M-9. Prior to assembling the spigot end into the bell end, both ends shall be thoroughly cleaned and the rubber gasket and the bell end of the previously laid pipe shall be coated with vegetable soap furnished by the manufacturer.
- B. For each crew that is inexperienced in laying this type of pipe, one reliable man shall be furnished by the manufacturer's representative with and instructed in the use of a set of steel inserts and feeler gauge to be used in determining if the rubber gasket is in proper position prior to the joint being pushed or pulled home. An experienced crew may omit the use of a feeler gauge. In either method of operation, the Contractor shall be responsible for a good, proper and sound joint. Any joint found in later tests to be faulty shall be repaired to the satisfaction of the Engineer.
- C. After the pipe is "home" a cloth diaper (minimum 7 inches wide) supplied by the pipe manufacturer shall be placed and wired around the outside of the pipe at the joint. This diaper shall serve as a form for pouring a 1:2 cement sand grout in the external recess.
- D. Great care shall be taken to prevent the concrete core or jacket or the steel bell and spigot rings from being damaged, and any core, jacket or ring damaged in any way shall be repaired or replaced by the Contractor to the satisfaction of the Engineer.

### 3.04 DUCTILE IRON PIPE

- A. Ductile iron pipe (DIP) shall be installed in accordance with the requirements of the Ductile Iron Pipe Handbook published by the Ductile Iron Pipe Research Association, and AWWA C600.
- B. Where it is necessary to cut ductile iron pipe in the field, such cuts shall be made carefully in a neat workmanlike manner using approved methods to produce a clean square cut. The outside of the cut end shall be conditioned for use by filing or grinding a small taper, at an angle of approximately 30 degrees.
- C. UNLESS OTHERWISE APPROVED BY THE ENGINEER, FIELD WELDING OF DUCTILE IRON WILL NOT BE PERMITTED.

### 3.05 PVC/CPVC AND HDPE PIPE

- A. Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC) and High Density Polyethylene (HDPE) pipe shall be laid and joints assembled according to the respective

manufacturer's recommendation. PVC pipe installation shall comply with applicable sections of the Uni-Bell PVC Pipe Association Recommended Standard Specifications.

- B. Plastic piping shall not be installed when the temperature is less than 60°F except as otherwise recommended by the manufacturer and approved by the Engineer.

### 3.06 CARBON AND STAINLESS STEEL PIPE

- A. Installation of steel pipe shall be by skilled workmen and shall conform to the applicable sections of AWWA Manual M-11. Joints for steel piping shall be either screwed, welded, or flanged as shown on the Drawings or as specified.
- B. Welding in the field shall be performed only when requested on the shop drawings and permitted by the Engineer for carbon steel pipe. No welding of stainless steel pipe shall be allowed in the field. All field welds shall be radiographically inspected.
- C. Installation of the steel casing pipe shall be by skilled workmen and in accordance with the best standard practice for steel pipe installation. Joints for steel casing pipe shall be butt welded.
  - 1. The boring equipment to be used for installing the jacked casing shall be of such size and capacity to allow the boring to proceed in a safe and expeditious manner. The installation of the casing and boring of the hole shall be done simultaneously to avoid cave ins or settlement and for safety of traffic above.
  - 2. The Contractor shall check the vertical and horizontal alignment of the casing by survey instrument at least once during each four feet of advance, or as directed by the Engineer. Pits shall be well sheeted and braced as necessary for safe and adequate access for workmen, inspectors and materials and shall be of a size suitable to equipment and material handling requirements.
  - 3. Under no conditions shall jetting or wet boring of encasement under pavement be allowed.
  - 4. After installation of the carrier pipe, each end of the casing pipe shall be made watertight with a brick masonry bulkhead. In addition, a Class B concrete cradle shall be provided from each end of the bulkhead to the first pipe joint outside of the bulkhead.

### 3.07 COPPER PIPE

- A. Installation of copper pipe shall be by skilled workman in accordance with the manufacturer's recommendations. Use teflon tape at all fittings unless otherwise required for intended service. Install unions at the connections to each piece of equipment to allow removal of equipment without dismantling connecting piping.
- B. Wall sleeves shall be provided for all piping passing through exterior walls and shall be of the same material as the piping to which it is joined. All wall sleeves shall be provided with an acceptable waterstop.
- C. The Contractor shall provide hot and cold water mains with branches and risers complete from point indicated on the Drawings running to all fixtures and other outlets indicated. Mains and branches shall be run generally as shown on the Drawings. The Contractor shall provide all interior water piping, branches, and risers as shown on the Drawing and shall make

connections to all plumbing fixtures, hose bibs, wall hydrants, and other points requiring water under this and other Divisions of the Specifications.

- D. All water mains and branches shall be pitched at least one (1) inch in twenty-five (25) feet toward fixtures. The piping installation shall be arranged so that the entire system can be drained through fixture supply connections.
- E. Unions shall be installed at the connections to each piece of equipment to allow for removal of equipment without dismantling connecting piping.
- F. Joints 1-1/4 inches and larger shall be made with silver solder. For joints less than 1-1/4 inches and all valves (regardless of size) use 95/5 solder. Soldered joints shall be prepared with a non-corrosive paste flux in accordance with manufacturer's instructions. All joints shall be thoroughly cleaned with emery cloth and reamed out before assembly. Acid core solder will not be permitted.

### 3.08 POLYPROPYLENE AND POLYVINYLIDENE FLUORIDE PIPE

- A. The pipe and fittings shall be of the same material for both inner and outer walls of the pipe.
- B. Polypropylene pipe shall be black UV stabilized co-polymer conforming to the requirements of ASTM D-4101. Where used in exterior locations, material shall provide a weathering resistance absent of further coating, covering, or wrapping unless specified herein or shown on the Drawings.
- C. Polyvinylidene fluoride shall comply with ASTM D-3222. The material shall provide a translucence, thus enabling a visual inspection of liquid in the annular space between the inner and outer walls.
- D. Where elastomers are selected by the manufacturer, such selection shall be with regard to the application of the chemical solution to be transported.
- E. Pipe and associated fittings shall be rated for not less than 75 psi at 73°F.
- F. Double-walled pipe and fittings shall be molded and used throughout. Molded ribs shall maintain permanent alignment of the inner and outer walls of the pipe and fittings.
- G. Ends of fittings shall be flush, creating a single plane.
- H. Wall thickness of the inner and outer walls of double-walled pipe shall be identical, providing identical pressure ratings.
- I. Where shown on the Drawings, a leak detection system of the manufacturer's design shall be supplied, complete with vent pipes, manual drain outlet, and electric float switch. Switch shall be rated for 0.080 amps at 120 VAC.
- J. Polypropylene and polyvinylidene fluoride pipe shall be laid and joints assembled by skilled workers according to the respective manufacturer's recommendations. Joints shall be butt fusion welded.
- K. Plastic piping shall not be installed when the ambient temperature is less than 60°F except as otherwise recommended by the manufacturer and approved by the Engineer.



- L. Wall sleeves shall be provided where piping passes through exterior walls. All sleeves shall be provided with an acceptable waterstop.
- M. Double walled pipe shall be Asahi/American or equal. Pipe shall be furnished complete with flanges or other appurtenant fittings by the same manufacturer and made especially for use with the double walled pipe.

### 3.09 JOINTS IN PIPING

- A. Restrained joints shall be provided on all pipe joints as specified herein and shown on the Drawings. Restrained joints shall be made up similar to that for push on joints.
- B. Push-on joints include a single rubber gasket which fits into the bell end of the pipe. The gasket shall be wiped clean, flexed and then placed in the socket. Any bulges in the gasket which might interfere with the entry of the plain end of the pipe shall be removed. A thin film of lubricant shall be applied to the gasket surface which will come into contact with the spigot end of the pipe. The lubricant shall be furnished by the pipe manufacturer. The plain end of the pipe, which is tapered for ease of assembly, shall be wiped clean and a thick film of lubricant applied to the outside. The pipe shall be aligned and carefully entered into the socket until it just makes contact with the gasket. The joint assembly shall be completed by entering the pipe past the gasket until it makes contact with the bottom of the socket. The pipe shall be pulled "home" with an approved jack assembly as recommended by the pipe manufacturer. If assembly is not accomplished by reasonable force, the plain end shall be removed and the condition corrected.
- C. Flanged joints shall be brought to exact alignment and all gaskets and bolts or studs inserted in their proper places. Bolts or studs shall be uniformly tightened around the joints. Where stud bolts are used, the bolts shall be uniformly centered in the connections and equal pressure applied to each nut on the stud. Pipes in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot.
- D. Mechanical joints shall be made up with gaskets, glands and bolts. When a joint is to be made up, the bell or socket and plain end shall be cleaned and washed with a solution of mild soap in water; the gland and gasket shall be slid onto the plain end and the end then entered into the socket until it is fully "home" on the centering ring. The gasket shall then be painted with soapy water and slid into position, followed by the gland. All bolts shall be inserted and made up hand tight and then tightened alternately to bring the gland into position evenly. Excessive tightening of the bolts shall be avoided. All nuts shall be pulled up using a torque wrench which will not permit unequal stresses in the bolts. Torque shall not exceed the recommendations of the manufacturer of the pipe and bolts for the various sizes. Care shall be taken to assure that the pipe remains fully "home" while the joint is being made. Joints shall conform to the applicable AWWA Specifications.
- E. Threaded and/or screwed joints shall have long tapered full depth threads to be made with the appropriate paste or jointing compound, depending on the type of fluid to be processed through the pipe. All pipe up to, and including 1 1/2 inches, shall be reamed to remove burr and stood on end and well pounded to remove scale and dirt. Wrenches on valves and fittings shall be applied directly over the joint being tightened. Not more than three pipe threads shall be exposed at each connection. Pipe, in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot. Joints in all piping used for chlorine gas lines shall be made up with a glycerine and litharge cement. Joints in plastic piping (PVC/CPVC) shall be laid and joints made with compounds recommended by the manufacturer. Installation shall conform to the

requirements of ASTM D2774 and ASTM D2855. Unions required adjacent to valves and equipment.

- F. Soldered joints shall have the burrs removed and both the outside of pipe and the inside of fittings shall be thoroughly cleaned by proper tools recommended for that purpose. Flux shall be applied to both pipe and inside of fittings and the pipe placed into fittings and rotated to insure equal distribution of flux. Joints shall be heated and solder applied until it shows uniformly around the end of joints between fitting and pipe. All joints shall be allowed to self cool to prevent the chilling of solder. Combination flux and solder paste manufactured by a reputable manufacturer is acceptable. Unions required adjacent to valves and equipment.
- G. Welded joints shall be made by competent operators in a first class workmanlike manner, in complete accordance with ANSI B31.1 and AWWA C206. Welding electrodes shall conform to ASTM A233, and welding rod shall conform to ASTM A251. Only skilled welders capable of meeting the qualification tests for the type of welding which they are performing shall be employed. Tests, if so required, shall be made at the expense of the Contractor, if so ordered by the Engineer. Unions shall be required adjacent to valves and equipment.
- H. Copper joints shall be thoroughly cleaned and the end of pipes uniformly flared by a suitable tool to the bevels of the fittings used. Wrenches shall be applied to the bodies of fittings where the joint is being made and in no case to a joint previously made. Dimensions of tubing and copper piping shall be in complete accordance with the fittings used. No flare joints shall be made on piping not suited for flare joints. Installations for propane gas shall be in accordance with NFPA 54 and/or 58.
- I. Solvent or adhesive welded joints in plastic piping shall be accomplished in strict accordance with the pipe manufacturer's recommendations, including necessary field cuttings, sanding of pipe ends, joint support during setting period, etc. Care shall be taken that no droppings or deposits of adhesive or material remain inside the assembled piping. Solvent or adhesive material shall be compatible with the pipe itself, being a product approved by the pipe manufacturer. Unions are required adjacent to valves and equipment. Sleeve-type expansion joints shall be supplied in exposed piping to permit 1-inch minimum of expansion per 100 feet of pipe length.
- J. Dielectric unions shall be installed wherever dissimilar metals are connected except for bronze or brass valves in ferrous piping. Unions shall be provided downstream of each valve with screwed connections. The Contractor shall provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.
- K. Eccentric reducers shall be installed where air or water pockets would otherwise occur in mains because of a reduction in pipe size.
- L. Joints in polypropylene and polyvinylidene fluoride pipe shall be butt fusion weld. All butt welding shall follow the requirements of ASTM D-2657 and the manufacturer's recommendations.

### 3.10 FLUSHING AND TESTING

- A. All piping shall be properly flushed and tested unless specifically exempted elsewhere in the Specifications or otherwise approved by the Engineer. Air and gas pipelines shall be flushed and tested with compressed air. Gravity sewer piping shall be flushed and tested as specified in Section 02604 - Utility Structures. All other liquid conveying pipelines shall be flushed and tested with water. The Contractor shall furnish and install all means and

apparatus necessary for getting the air or water into the pipeline for flushing and testing including pumps, compressors, gauges, and meters, any necessary plugs and caps, and any required blow-off piping and fittings, etc., complete with any necessary reaction blocking to prevent pipe movement during the flushing and testing. All pipelines shall be flushed and tested in such lengths or sections as agreed upon among the Owner, Engineer, and Contractor. Test pressures shall be as specified in Section 15390 – Schedules, and shall be measured at the lowest point of the pipe segment being tested. The Contractor shall give the Owner and Engineer reasonable notice of the time when he intends to test portions of the pipelines. The Engineer reserves the right, within reason, to request flushing and testing of any section or portion of a pipeline.

- B. The Contractor shall provide water for all flushing and testing of liquid conveying pipelines. Raw water or non potable water may be used for flushing and testing liquid pipelines not connected to the potable water system. Only potable water shall be used for flushing and testing the potable water system.
- C. Air and gas piping shall be completely and thoroughly cleaned of all foreign matter, scale, and dirt prior to start up of the air or gas system.
- D. At the conclusion of the installation work, the Contractor shall thoroughly clean all new liquid conveying pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, etc., which may have entered the pipe during the construction period. If after this cleaning any obstructions remain, they shall be corrected by the Contractor, at his own expense, to the satisfaction of the Engineer. Liquid conveying pipelines shall be flushed at the rate of at least 2.5 feet per second for a duration suitable to the Engineer or shall be flushed by other methods approved by the Engineer.
- E. Compressed/service air and gas piping shall be flushed by removing end caps from the distribution lines and operating one (1) compressor, in accordance with the manufacturer's instructions.
- F. After flushing, all air piping shall be pressure and leak tested prior to coating and wrapping of welded joints. Immediately upon successful completion of the pressure and leak test, welded joints shall be thoroughly cleaned of all foreign matter, scale, rust, and discoloration and coated in accordance with the Specifications.
- G. All process air piping shall be leak tested by applying a soap solution to each joint. Leak tests shall be conducted with one (1) blower in service at normal operating pressure.
- H. During testing the piping shall show no leakage. Any leaks or defective piping disclosed by the leakage test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.
- I. All buried process air piping shall be pressurized to 25 psig and tested for leaks by applying a soap solution to each joint. The air supply shall be stopped and the pipe pressure monitored. System pressure shall not fall by more than 0.5% of the 25 psig test pressure over a one hour test period. Should the system fail to hold the required pressure for one hour, the cause shall be determined and corrected and the test repeated until a successful test of the entire system is obtained.
- J. Field leakage tests shall be performed for all submerged process air piping. The procedure shall consist of operating the system under clear nonpotable water for visual identification of

all leaks. All field leakage tests shall be witnessed by the Engineer. All submerged piping shall be installed free of any leaks.

- K. After flushing, all liquid conveying pipelines shall be hydrostatically tested at the test pressure specified in the appropriate Piping System Schedule in Section 15390 – Schedules. The procedure used for the hydrostatic test shall be in accordance with the requirements of AWWA C600. Each pipeline shall be filled with water for a period of no less than 24 hours and then subjected to the specified test pressure for 2 hours. During this test, exposed piping shall show no leakage. Allowable leakage in buried piping shall be in accordance with AWWA C600.
- L. Any leaks or defective pipe disclosed by the hydrostatic test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.
- M. After flushing, all gas piping shall be leak tested in accordance with all local codes and regulations and in conformance with the recommendations or requirements of any National Institute or Association for the specific service application.

### 3.11 DISINFECTION

- A. All pipe and fitting connected to and forming a part of a potable water supply shall be disinfected in accordance with the procedures described in AWWA C 651. Disinfection shall also be in accordance with the requirements of the North Carolina Division of Environmental Health and the Owner.
- B. Disinfection shall be accomplished after the pipe has been flushed, if applicable, and passed the hydrostatic test. Such piping shall be filled with 50 parts per million (PPM) of chlorine and held in contact for not less than 24 hours. Final tests after 24 hours contact time shall show a minimum residual chlorine content of 10 ppm in all parts of the system. Disinfection shall be repeated as often as necessary, and as directed by the Engineer and/or NCDEH and/or the Owner until the minimum residual chlorine content of 10 ppm has been reached. The Contractor shall obtain certificates of satisfactory bacteriological tests and furnish them to the Owner before the request is made for acceptance of the work. The Contractor shall furnish and install, at his own expense, all means and apparatus necessary for performing the disinfection. The chlorine solution shall be thoroughly flushed out prior to placing the new sections of pipe in service. The Contractor is cautioned that the spent chlorine solution must be disposed of in such a way as not to be detrimental to animal, plant, or fish life. Chlorine residual tests will be made after flushing to assure that residual is not in excess of 1 ppm at any point in system.

### 3.12 PAINTING AND COLOR CODING SYSTEM

- A. All exposed piping specified shall be color coded in accordance with the Owner's standard color designation system for pipe recognition and in accordance with Section 15030 – Piping and Equipment Identification Systems. In the absence of a standard color designation system, the Engineer will establish a standard color designation for each piping service category from color charts submitted by the Contractor in compliance with Section 09900 – Painting.
- B. All piping specified in this Section shall be painted in accordance with Section 09900 – Painting, except as follows:
  - 1. Copper pipe

2. Stainless steel pipe. Flanges and supports or hangers shall be painted.

- - END OF SECTION - -



SECTION 15002  
REINFORCED CONCRETE PIPE

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 – PRODUCTS

2.01 REINFORCED CONCRETE SEWER PIPE

- A. Reinforced concrete sewer pipe (RCP) shall be manufactured in accordance with ASTM C 76, Wall Type B or C, unless otherwise specified herein; and shall be of the class that equals or exceeds the pipe class as specified in Section 15390 - Schedules. Minimum pipe laying lengths shall be four (4) feet. Portland cement shall conform to ASTM C 150, Type II.
- B. Pipe shall have bell and spigot ends with O ring rubber gaskets. The gaskets shall be smooth solid rubber of circular and uniform cross section conforming to ASTM C 443. The spigot end of the pipe shall contain a special groove or slot to receive and hold the gasket in position during the joint assembly. The complete joint shall be subjected to hydrostatic tests conforming to ASTM C 443.
- C. All pipe and specials shall be aged at the manufacturing plant for at least fourteen (14) days before delivery to the job site.
- D. The interior of all pipe shall have a heavy bodied coal tar coating. The coating shall consist of two (2) coats of Ruff Stuff 2100, as manufactured by Indurall Coatings, Inc., Bitumastic Super Service Black, as manufactured by KOP-COAT, Inc., or equal. Each coat shall have a minimum thickness of 12 mils dry film. The coal tar shall be applied as recommended by the manufacturer. Steel or cast iron bell wall fittings shall be provided wherever the pipe is connected to a structure.

2.02 REINFORCED CONCRETE LOW-HEAD PRESSURE PIPE (RCP-ASTM C361)

- A. Reinforced concrete low head pressure pipe shall be manufactured in accordance with ASTM C361, and shall be of the class that equals or exceeds the pipe class as specified in Section 15390 - Schedules. Minimum pipe laying lengths shall be twelve (12) feet.
- B. Pipe shall have steel joint rings with O ring rubber gaskets. The gaskets shall be smooth solid rubber of circular and uniform cross section and shall be confined in an annular space formed by shoulders on the bell and spigot or in a special groove in the spigot to receive and hold the gasket in position during the joint assembly. The complete joint shall be subjected to hydrostatic tests conforming to ASTM C361.

- C. All pipe and specials shall be aged at the manufacturing plant for at least fourteen (14) days before delivery to the job site.
- D. The interior of the pipe shall have a heavy bodied coal tar coating. The coating shall consist of two (2) coats of Ruff Stuff 2100, as manufactured by Indurall Coatings, Inc., Bitumastic Super Service Black, as manufactured by KOP COAT, or equal. Each coat shall have a minimum thickness of 12 mils dry film. The coal tar shall be applied as recommended by the manufacturer. Steel or cast iron bell wall fittings shall be provided wherever the pipe is connected to a structure.

#### 2.03 CONCRETE CULVERT AND DRAIN PIPE

- A. All reinforced concrete culvert and drain pipe shall be manufactured in accordance with ASTM C76, Wall Type B or C, and shall be of the class that equals or exceeds the pipe class as specified herein or as shown on the Contract Drawings. Minimum pipe laying lengths shall be four (4) feet. Testing shall be in accordance with Section 02604 – Utility Structures. Portland cement shall conform to ASTM C150, Type II.
- B. Joints for the reinforced concrete culvert and drain pipe shall have bell and spigot ends with flexible plastic gaskets meeting the requirements of AASHTO M198, Type B.
- C. All pipe shall be aged at the manufacturing plant for at least fourteen (14) days before delivery to the job site.

- - END OF SECTION - -



SECTION 15006  
DUCTILE IRON PIPE

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. All ductile iron pipe and specials shall be marked with the manufacturer's name or trademark, size, weight, thickness class, the date of manufacture, and the word "Ductile".
- B. Ductile iron pipe (DIP) of the sizes shown or specified shall conform to ANSI A21.51 (AWWA C151), Grade 60 42 10 for ductile iron pipe centrifugally cast in metal molds or sand lined molds. All ductile iron pipe shall conform to ANSI A21.50 (AWWA C150) for thickness design and shall be supplied in 18 or 20 foot nominal lengths or as required to meet the requirements of the Drawings. Fittings and specials shall be cast iron or ductile iron, conforming to the requirements of ANSI A21.10 (AWWA C110) or ANSI A21.53 (AWWA C153) and shall have a minimum rated working pressure of 250 psi.
- C. Minimum Class 53 pipe shall be used for flanged spools.
- D. Reference Section 15000, Basic Mechanical Requirements

PART 2 – PRODUCT

2.01 DUCTILE IRON PIPE AND FITTINGS

- A. All pipe and fittings, with the exception of glass lined pipe and sleeves, shall be cement mortar lined. Linings shall conform to American Standard Specifications for Cement Mortar Lining for Cast Iron Pipe and Ductile Iron Pipe and Fittings, ANSI A21.4 (AWWA C104) and shall be standard thickness. The mortar lining shall be protected with the bituminous seal coat. All buried DIP and fittings shall have a bituminous coating on the exterior surfaces in accordance with ANSI A21.51 (AWWA C151). All exposed DIP and fittings shall have a shop applied prime coat in accordance with Section 09900 - Painting.
- B. Glass lined ductile iron pipe shall be furnished and installed where specified in the Exterior Piping System Schedule. The finished lining shall be from 0.008 inch to 0.012 inch thick, hardness of from 5 to 6 on the Mohs Scale, density of from 2.5 to 3.0 grams per cubic centimeter as measured in accordance with the requirements of ASTM D792 and be capable of withstanding a thermal shock of 350°F without crazing, blistering, or spalling. The lining shall be Ervite Type SG 14, as manufactured by the Ervite Corporation, Erie, Pa., Ferrook MEH 32, by Water Works Supply & Mfg., Co., Marysville, CA, or equal.
- C. Cutting of glass lined pipe in the field shall be limited to only one piece per run of pipe, and this shall be for closure purposes only. Spalling of the glass liner shall be no more than 1/8 inch back from the cut. Flanges and bolt holes on spool pieces shall be aligned prior to glassing and shall be sealed and tested prior to shipment in accordance with the

manufacturer's recommendation. Warping of flanges and/or pipe may be cause for rejection as determined by the Engineer.

- D. Requirements for various types of joints are described in the following paragraphs. UNLESS OTHERWISE NOTED HEREIN OR ON THE DRAWINGS, ALL EXPOSED DUCTILE IRON PIPING SHALL HAVE FLANGED JOINTS.
- E. Flanged joints and fittings shall have a minimum pressure rating of 250 psi with 125 lb. American Standard flanges. All flanges and fittings shall conform to the requirements of ANSI B16.1. Flanges shall be ductile iron and shall be of the threaded or screw on type. The face of the flanges shall be machined after installation of the flange to the pipe. No raised surface shall be allowed on flanges. Flanged pipe shall conform to the requirements of ANSI Specification A21.15, (AWWA C115). Pipe lengths shall be fabricated to meet the requirements of the Drawings.
- F. Gaskets shall be the "Ring Gasket" type, 1/8 inch minimum thickness, cloth inserted rubber, red rubber or neoprene and shall be suitable for the service intended. Gaskets for glass lined pipe shall be TORUSEAL flange gasket, or equal. Bolts shall be of the size and length called for and in accordance with the "American Standard" and comply with the requirements of the ANSI/AWWA Standards. The bolts for flanged joints shall be a minimum ASTM A307; Grade B carbon steel and be in accordance with ANSI A21.10, (AWWA C110). The bolts shall have hexagonal heads and nuts, no washers shall be used.
- G. Bell and spigot pipe shall be provided with push on, O ring rubber gasket, compression type joints and shall conform to the requirements of ANSI A21.11 (AWWA C111). Fittings and specials shall be supplied with mechanical joints as specified for mechanical joint pipe. If required by installation conditions, pipe shall have cast on lugs for adequately tying it together.
- H. Mechanical joints and fittings shall conform to the requirements of ANSI A21.11, (AWWA C111). Joints shall be made employing a tapered rubber gasket forced into a tapered groove with a ductile iron follower ring. If required by installation conditions, pipe and fittings shall have cast on lugs for adequately tying the pipe and fittings together. These shall be in conformance with standard practice and as outlined under the appropriate AWWA Specifications.
- I. Bolts for mechanical joints shall be high strength corrosion resistant low-alloy steel tee-head bolts with hexagonal nuts.
- J. Mechanical coupling joint pipe and fittings shall be split type, shouldered end. Coupling materials shall be malleable iron. Couplings shall have a minimum pressure rating and service equal to that of the connected piping. Gaskets shall be of rubber. Bolts and nuts shall be heat treated carbon steel track bolts and shall be plated. After installation, buried couplings shall receive two heavy coats of coal tar epoxy (min. 24 mil thickness) which is compatible with the finish of the couplings. Couplings shall be as manufactured by Victaulic Company of America Style 44, or equal.
- K. Restrained joint pipe shall consist of factory manufactured bolted retainer rings, ductile iron locking segments held in place by rubber retainers, or ductile iron retaining rings that lock over the bell of the joint and are secured to prevent rotation, and factory welded retainer beads or rings on the spigot of the pipe. All components of the bolted or snap ring assemblies shall be constructed of corrosion-resistant, high strength, low-alloy steel. Restrained joint pipe shall be Flex-Ring or Lock-Ring type joints as manufactured by

American Cast Iron Pipe Company, HP LOK or TR Flex as manufactured by US Pipe, Bolt-Lok or Snap-Lok as manufactured by Griffin Pipe Products, TR Flex or Super Lock as manufactured by Clow Water Systems Co., or approved equal.

- L. Restrained fittings for piping systems 16-inches in diameter and greater shall have factory restraint systems identical to the factory restrained joint pipe specified in Item K above. All fittings shall be minimum pressure Class 250 unless otherwise specified.
- M. Restrained fittings for pipe systems 14-inches in diameter and smaller shall be Mechanical Joint fittings with restraint assemblies such as Stargrip by Star Pipe Systems, Mega Lug by EBAA Iron, ONE LOK by Sigma, Grip Ring by Romac, or approved equal. Where threaded-rods are allowed, the rods and tabs shall be designed for the specified restraint system design pressure, shall have lengths less than 10 feet between fittings, and shall be painted with two heavy coats of coal tar epoxy after installation.
- N. The manufactured systems for thrust restraint indicated above shall be used where restrained joint ductile iron pipe and fittings are specified or indicated on the drawings. Gripping gaskets are not an acceptable form of restraint. Thrust restraint and harnessing systems such as threaded-rods, friction clamps, retainer glands shall be used only where specifically specified herein, indicated on the drawings or if allowed by the Engineer in isolated applications where conditions warrant and necessitate their use. Concrete thrust blocks may be used in accordance with the schedule indicated on the drawings, if applicable.
- O. Cast Iron Soil Pipe shall conform to the standards of the Cast Iron Soil Pipe Institute (CISPI) Specification HS-67, and also ANSI Specification A-112.5.2 for Hub & Spigot pipe or A.112.5.1 for Hub & Spigot pipe or A.112.5.1 for No-Hub Pipe. Pipe class shall be "Extra Heavy: (XH).

- - END OF SECTION - -



## SECTION 15008

### PVC

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

#### PART 2 – PRODUCTS

##### 2.01 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. PVC pipe and fittings shall be manufactured in accordance with ASTM D 1785, D 1784 and F 441, "normal impact" pipe, Schedule 40 or 80 as specified.
- B. Fittings used with this pipe shall be socket type or flanged type as specified herein, in Section 15390 - Schedules, or indicated on the Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.
- C. PVC pipe shall be Type 1 Grade 1 conforming to ASTM D 1784 and D 1785. Fittings shall conform to the following standard specifications:
  - Socket Type (Schedule 40); ASTM D 2466
  - Socket Type (Schedule 80); ASTM D 2467
- D. Provide flanged fittings of the same material as the specified pipe and material conforming to ANSI B16.5 at all valves and equipment with Teflon filled or natural rubber gaskets. Bolts shall be type 316 stainless steel for flanged joints. Flanges are not required at true (double) union valves.
- E. Solvent cement for socket type joints shall conform to ASTM D 2564 for PVC pipe and fittings. Solvent cement for sodium hypochlorite service shall be Weld-On 724 as manufactured by IPS Corporation, or equal.
- F. Gravity sewer pipe shall be SDR 26 and shall conform to all the requirements of ASTM D3034. The pipe shall be capable of withstanding the overburden pressures determined by the depth of burial in the field. Pipe shall be suitable for conveying sanitary sewage.
  - 1. Pipe material shall be made from clean, virgin, NSF approved Class 12454 or 12364 compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet (±1 inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed material shall not be accepted.

2. The pipe shall have bell and spigot ends and be water tight. Pipe shall have an integral elastomeric-gasket bell end. Gaskets shall be in conformance with ASTM F477.
3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 115 psi for all sizes when tested in accordance with D2412.

- - END OF SECTION - -

SECTION 15095  
VALVES, GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install, complete with all assemblies and accessories, all valves shown on the Drawings and specified herein including all fittings, appurtenances and transition pieces required for a complete and operable installation.
- B. All valves shall be constructed of first quality materials which have strength, wearing, and corrosion resistance characteristics entirely suitable for the types of service for which the individual valves are designated. Except where noted otherwise, valves designated for water service shall conform to pertinent sections of the latest revision of AWWA C500 Specifications. Cast iron valve bodies and parts shall meet the requirements of the latest revision of ASTM Designation A 126, "Standard Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class B."
- C. All valve body castings shall be clean, sound, and without defects of any kind. No plugging, welding, or repairing of defects will be allowed.
- D. Valves shall have flanged ends for exposed service and mechanical joint ends for buried service, unless otherwise shown on the Drawings or specified herein. Flanged ends shall be flat faced, 125 lb. American Standard unless otherwise shown or specified in accordance with ANSI B16.1. All bolt heads and nuts shall be hexagonal of American Standard size. The Contractor shall be responsible for coordinating connecting piping. Valves with screwed ends shall be made tight with Teflon tape. Unions are required at all screwed joint valves.

1.02 SUBMITTALS

- A. The Contractor shall furnish to the Owner, through the Engineer, a Performance Affidavit where required in individual valve specifications, utilizing the format specified in Section 11000, Equipment General Provisions. Performance tests shall be conducted in accordance with the latest revision of AWWA C500 and affidavits shall conform to the requirements of the Specifications
- B. Shop Drawings conforming to the requirements of Section 01300, Submittals, are required for all valves, and accessories. Submittals shall include all layout dimensions, size and materials of construction for all components, information on support and anchoring where necessary, pneumatic and hydraulic characteristics and complete descriptive information to demonstrate full compliance with the Documents. Shop Drawings for electrically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the electrical power supply and remote status and alarm indicating devices. Electrical control schematic diagrams shall be submitted with the Shop Drawings for all electrical controls. Diagrams shall be drawn using a ladder type format in accordance with JIC standards. Shop Drawings for pneumatically operated/controlled valves shall

include all details, notes, and diagrams which clearly identify required coordination with the compressed air (service air) system and electrical controls.

- C. Operation and maintenance manuals and installation instructions shall be submitted for all valves and accessories in accordance with the Specifications. The manufacturer(s) shall delete all information which does not apply to the equipment being furnished.

### 1.03 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall provide the services of a qualified representative of the manufacturer(s) of the equipment named below to check out and certify the installation(s), to supervise the initial operation, and to instruct the Owner's operating personnel in proper operation and maintenance procedures in accordance with the following schedule:

Item	Valve/Operator Type	Minimum On-Site Time Requirements
1.	Automatic Control Check Valve	One (1) 8-hour day
2.	Surge Anticipators	One (1) 8-hour day
3.	Motor Operated Modulating Valves	One (1) 8-hour day
4.	Motor Operated Open-Close Valves (required only if manufacturer is other than for Item 3 above)	One (1) 8-hour day
5.	Pneumatic Hydraulic Cylinder Operated Valves	One (1) 8-hour day

- B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day he is at the project.
- C. A written report covering the representative's findings and installation approval shall be mailed directly to the Engineer covering all inspection and outlining in detail any deficiencies notes.
- D. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

## PART 2 – PRODUCTS

### 2.01 FLOW INDICATORS

- A. Flow indicators shall be the Akron ball type as manufactured by Brooks Instrument Co., Fischer and Porter, or equal, and shall have bronze bodies, glass dome, and plastic ball.

### 2.02 CORPORATION STOPS

- A. Corporation stops shall be of bronze with tapered male iron pipe threads on inlets and outlets. Terminal outlets shall have screwed bronze hex head dust plugs or caps. Unions shall be used on all corporation stop outlets with connecting piping. Corporation stops shall have a minimum working pressure rating of 250 psi and shall be as manufactured by Mueller Co., Hays Mfg. Div. of Zurn Industries, or equal.



## 2.03 FLOOR BOXES

- A. Floor boxes shall be provided for all nut operated or floor accessed valves. Floor boxes shall be of the adjustable, sliding type, cast iron, suitable to withstand heavy traffic, as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., or equal. The covers shall be marked with appropriate designations of piping contents (i.e.: water, sewer) and bases shall be the round type. All nut operated valves in this Section shall be clearly identified by stainless steel or laminated plastic identification tags. The tags shall be permanently affixed to the inside of the floor boxes, under grating, etc. and shall bear the embossed letters which clearly identify each valve by its appropriate designation.
- B. Two (2) valve operating wrenches shall be supplied in 4-foot lengths with tee handles for each size nut supplied. Valve wrenches shall be Model No. F 2520 as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Figure No. 122, or equal.

## 2.04 VALVE BOXES

- A. The Contractor shall furnish and install valve boxes as shown on the Drawings and specified herein.
- B. All valve boxes shall be placed so as not to transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve. The ground in the trench upon which the valve boxes rest shall be thoroughly compacted to prevent settlement. The boxes shall be fitted together securely and set so that the cover is flush with the finished grade of the adjacent surface. A concrete pad as detailed on the Drawings shall be provided around the valve box, sloped outwards.
- C. All valve boxes shall be 2-piece cast iron, sliding type, 5-1/4" shaft, with heavy duty traffic weight collar and the lid marked with the appropriate carrier product (i.e.: WATER). Boxes shall be as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Charlotte Pipe and Foundry Company, or equal.

## 2.05 STRAINERS

- A. Y Strainers shall be Y pattern cast iron body, flanged or screwed ends with stainless steel or Monel, 20 mesh strainers. Strainers shall be 200 psi, cold water service strainers, as manufactured by WATTS, Crane Co., Zurn, or equal.
- B. Caustic service Y strainers shall be provided as shown on the drawings. Strainers shall be full port full flow design manufactured of 304 or 316 stainless steel body. Y strainers shall be furnished with flanged ends. The strainer screen shall be 1/32-inch perforation, easily removable, manufactured of the same material as the valve body.
- C. Stainless steel Y strainers shall be provided as shown on the drawings. Strainers shall be full port full flow design manufactured of 304 or 316 stainless steel body. Y strainers shall be furnished with flanged ends. The strainer screen shall be 1/32-inch perforation, easily removable, manufactured of the same material as the valve body.
- D. PVC and CPVC y-strainers shall be provided in PVC and CPVC piping and as shown on the Drawings. Strainer shall be provided with PVC or CPVC body and end cap, EPDM or Viton seal as required for the chemical service, and 20 mesh screen. Temperature rating shall be 30°F to 140°F, and pressure rating shall be 150 psi @ 70°F, non-shock. PVC and CPVC y-Strainers shall be as manufactured by Asahi/America, Hayward, or equal.

- E. Manually cleaned strainers shall be the duplex basket tapered plug type.
1. Strainers 3 inches in diameter and larger shall have flanged ends conforming to ANSI B16.1 125/150 pound standard.
  2. Strainers less than 3 inches in diameter shall have screwed end connectors, unless otherwise shown on the Drawings.
  3. Strainers shall be constructed with an ASTM A48, Class 30 cast iron body, ductile iron trim, removable 0.045-inch staggered hole perforation, 304 stainless steel filter baskets and gauges on the inlet and outlet.
  4. All strainers shall be suitable for 125 psi service.
  5. Switching flow from one basket to the other shall be accomplished by moving the handle through a 180° arc. The switching operation shall not stop flow through the strainer and shall provide for on line removal of either basket with the other basket functional. The plug shall be automatically positioned with integral stops and shall be easily lifted and resealed under pressure.
  6. The strainer shall be designed to minimize the possibility of material bypassing the plug while being rotated and to prevent debris from building up under the plug. The strainer covers shall be designed for quick opening with swing away yoke.
  7. Each basket compartment shall have a side drain outlet.
  8. All strainers shall be provided with support legs.
  9. Duplex basket strainers shall be similar to the Model 53BTX as manufactured by Hayward, or equal.
- F. PVC and CPVC simplex basket strainers shall be provided in PVC and CPVC piping as shown on the Drawings. 1/2"-4" strainers shall be one-piece molded body with (3) ports to facilitate straight-thru flow pattern or u-shape flow pattern as required. Connections shall be true union type to ease installation/future maintenance. The cover, vent plug, and drain plug shall all be hand-removable, requiring no tools. EPDM or Viton seals shall be used as required for chemical service, and internal baskets shall be 1/32" perforation (20-mesh) for 1/2"-1" sizes, and 1/8" perforation for 1-1/2"-8" sizes. 6" and 8" strainers shall be fabricated construction and shall contain flanged connections as standard. The pressure rating for 1/2"-8" sizes shall be 150 psi @ 70°F, non-shock. Strainers shall be manufactured by Hayward Industrial Products, or equal.

## 2.06 QUICK DISCONNECT COUPLINGS

- A. Quick disconnect type coupling for compressed/service air shall be provided where indicated on the Drawings. Coupling shall provide for instantaneous shutoff in socket end when lines are disconnected. Couplings shall be constructed of 316 stainless steel with a BUNA N O ring and integral safety lock. Couplings shall comply with Military Specification 4109 (interchangeable with standard plug of the same size).

## 2.07 BACKFLOW PREVENTERS

- A. Backflow preventer shall be the size shown on the Drawings and shall be of the double check valve principle. Backflow preventer installation shall include isolation valves and four test cocks, furnished as an assembly. For backflow preventers less than 2-1/2", the installation assembly also shall include a strainer. Isolation valves for backflow preventers shall be ball valves, except for size 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The backflow preventer shall be a WATTS 709, or equal.
- B. Reduced Pressure Backflow Preventer shall be of the size shown on the Drawings, and shall be of the reduced pressure principle type in accordance with AWWA Standards C510 and C511, with two (2) independent operating spring loaded check valves and one (1) spring loaded, diaphragm actuated, differential pressure relief valve shall be installed between the check valves. Backflow preventer shall be bronze body construction, with EPT rubber discs and Buna N and nylon diaphragm. Screws and springs shall be of stainless steel. End connections shall be screwed, unless otherwise specified or shown on the Drawings. Reduced pressure backflow preventer installations shall include isolation valves and four test cocks, furnished as an assembly. For reduced pressure backflow preventers less than 2-1/2" the installation assembly also shall include a strainer. Isolation valves for reduced pressure backflow preventers shall be ball valves, except for sizes 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The reduced pressure backflow preventer shall be as manufactured by Beeco Division, Hersey Products Inc., Aergap Model 6CM, WATTS 909, or equal.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

- A. Except where noted otherwise herein, all valves shall be installing and tested in accordance with the latest revision of AWWA C500. Before installation, all valves shall be lubricated, manually opened and closed to check their operation and the interior of the valves shall be thoroughly cleaned. Valves shall be placed in the positions shown on the Drawings. Joints shall be made as directed under the Piping Specifications. The valves shall be so located that they are easily accessible for operating purposes, and shall bear no stresses due to loads from the adjacent pipe. The Contractor shall be responsible for coordinating connecting piping.
- B. All valves shall be tested at the operating pressures at which the particular line will be used. Any leakage or "sweating" of joints shall be stopped, and all joints shall be tight. All motor operated and cylinder operated valves shall be tested for control operation as directed by the Engineer.
- C. Provide valves in quantity, size, and type with all required accessories as shown on the Drawings.
- D. Install all valves and appurtenances in accordance with manufacturer's instructions. Install suitable corporation stops at all points shown or required where air binding of pipe lines might occur. Install all valves so that operating handwheels or wrenches may be conveniently turned from operating floor but without interfering with access, and as approved by Engineer.

Unless otherwise approved, install all valves plumb and level. Valves shall be installed free from distortion and strain caused by misaligned piping, equipment or other causes.

- E. Valve boxes shall be set plumb, and centered with the bodies directly over the valves so that traffic loads are not transmitted to the valve. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face, if less than 4 feet.

### 3.02 SHOP AND FIELD TESTING

- A. Shop and field testing of valves shall be as follows:

1. Certified factory testing shall be provided for all components of the valve and operator system. Valves and operators shall be shop tested in accordance with the requirements in the latest revision of AWWA C500, including performance tests, leakage test, hydrostatic tests, and proof of design tests. The manufacturer through the Contractor shall submit certified copies of the reports covering the test for acceptance by the Engineer.
2. Shop testing shall be provided for the operators consisting of a complete functional check of each unit. Any deficiencies found in shop testing shall be corrected prior to shipment. The system supplier through the Contractor shall submit written certification that shop tests for the electrical/pneumatic system and all controls were successfully conducted and that these components provide the functions specified and required for proper operation of the valve operator system.
3. The Contractor shall conduct field tests to check and adjust system components, and to test and adjust operation of the overall system. Preliminary field tests shall be conducted prior to start up with final field tests conducted during start up. The factory service representative shall assist the Contractor during all field testing and prepare a written report describing test methods, and changes made during the testing, and summarizing test results. The service representative shall certify proper operation of the valve operator system upon successful completion of the final acceptance field testing.
4. Preliminary and final field tests shall be conducted at a time approved by the Engineer. The Engineer shall witness all field testing.
5. All costs in connection with field testing of equipment such as energy, light, lubricants, water, instruments, labor, equipment, temporary facilities for test purposes, etc. shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.
6. Preliminary field tests shall be conducted prior to start up and shall include a functional check of the entire valve operator system and all system components. Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly. The preliminary field test report must be approved by the Engineer prior to conducting final field acceptance tests. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation specified or otherwise directed by the Engineer.

7. Final field acceptance tests shall be conducted simultaneously with the start-up and field testing of the pumps, air compressors, process air blowers, etc. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing. Performance of pneumatic valves and compressed air system under normal operating conditions and during simulated power failures shall be checked.
8. Field testing shall include optimization of opening and closing times of the valves. The Contractor shall provide the means for accurate measurement of pipeline pressures as directed by the Engineer. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

- - END OF SECTION - -



## SECTION 15105

### CHECK VALVES

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.
- B. Valves shall be constructed of materials suitable for the intended service.

#### PART 2 – PRODUCTS

##### 2.01 SWING CHECK VALVES (WATER SERVICE)

- A. Unless otherwise specified, check valves 3 inches and less shall be bronze, Y pattern, swing check valves of the regrinding type. Valves shall have a minimum 200 psi non-shock cold water pressure rating and shall be as manufactured by Jenkins Bros. Corp., Crane Company, or equal.
- B. Check valves larger than 3 inches shall be cushioned swing check valves rated for a minimum working pressure of 200 psi and shall be of the "Shockless Swing Check" type as manufactured by G.A. Industries, or equal.
- C. Valve closure shall be controlled by an external weighted lever arm, the action of which is cushioned by a hydraulic oil or pneumatic cylinder. Counterweights and cushion cylinders shall be designed so that adjustments can be made in the field to minimize surge and to prevent backflow and hammering noises during actual service conditions. The hydraulic oil or pneumatic cushion system shall be completely self-contained.
- D. Valve bodies, cover discs, levers, and disc arms shall be constructed of heavy cast iron or cast steel fully conforming to the latest revision of ASTM A 126 Class B or Class WCB, respectively. Valve ends shall be Standard American 125 pound flat faced flanged, in accordance with ANSI B16.1. Each valve disc shall be suspended from a noncorrosive shaft which shall pass through a stuffing box and be connected on the outside of the valve to the cushion and counterweight mechanism.
- E. Valve seating shall be rubber to metal designed for drop tight shutoff. The body seat ring shall be made of bronze or stainless steel and the disc seat ring of 80 Durometer rubber. Body and disc seats shall be renewable.
- F. With the exception of the valve body and seat, all parts in contact with water shall be manufactured from noncorrosive materials. Internal corrosive surfaces shall be shop painted with two coats of epoxy for corrosion resistance. Exterior surfaces shall be painted in accordance with the requirements of Section 09900, Painting.

- - END OF SECTION - -





## SECTION 15109

### PLUG VALVES

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

#### PART 2 – PRODUCTS

##### 2.01 PLUG VALVES

- A. Plug valves shall be of the non-lubricated, eccentric seating plug type with synthetic rubber faced plugs as manufactured by DeZurik Company, Pratt, Milliken, or equal. All valves shall be provided with limit stops and rotate 90° from fully open to fully shut. The minimum working pressure for all valves shall be 150 psi, and the test pressure shall be at least 270 psi for valves up through 12-inch and at least 230 psi for valves 14-inch and larger. The port area of valves shall be at least 80 percent of full pipe area for valves less than 24 inches and 70 percent for valves 24 inches and larger, unless otherwise specified herein or indicated in the appropriate Valve Schedule in Section 15390, Schedules. The body materials shall be of epoxy coated cast iron or semi steel, unless specified otherwise. Seats shall have a welded overlay of 90 percent pure nickel and machined to a finish containing no stress cracks. Plug facings shall be of Hycar, or equal and completely suitable for use with domestic sewage.
- B. The shaft seal shall be either the bronze cartridge type with at least two O Rings, monolithic V Type, U-Cup Type, or pull down packing type. If monolithic V Type, U-Cup Type, or pull down packings are utilized, it shall be self-adjusting, self-compensating type. Packing shall be as manufactured by Chevron, or equal. Plug valves with pull down packings shall be designed with an extension bonnet so that repacking can be done without removal of the actuator.
- C. All buried valves shall have mechanical joint ends (unless otherwise shown), conforming to ANSI A21.11 (AWWA C 111), and shall be operated with a standard AWWA 2-inch square nut through a totally enclosed worm gear actuator. Valve boxes shall be installed with all buried plug valves and shall be as specified herein.
- D. Unless otherwise shown, all exposed valves 4 inches in diameter and larger shall have flanged ends conforming to ANSI B16.1 125/150 pound standard with face to face dimensions of standard plug valves. Valves smaller than 4 inches in diameter shall have screwed ends, unless otherwise noted.
- E. Valves 8 inches in diameter and larger shall be handwheel or floorstand operated where required or indicated on the Drawings through totally enclosed worm gear actuators, unless otherwise specified or shown on the Drawings. Valves 6 inches in diameter and smaller shall have lever operators, unless otherwise specified or noted on the Drawings. Manual

operators for plug valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators.

- F. The manufacturer shall certify that the plug valves are capable of operating in continuous duty service under these pressures and flow conditions.
- G. Each valve shall be hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.
- H. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

- - END OF SECTION - -

## SECTION 15390

### SCHEDULES

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

##### 1.02 PIPING SYSTEM SCHEDULES

- A. Piping requirements for this Section are outlined on the Drawings, and in the Piping System Schedule. In the absence of a specified test pressure, pipe shall be tested at a pressure 50 percent greater than the normal operating pressure as determined by the Engineer or 10 psig, whichever is greater unless the Schedule indicates that no test is required.
- B. If the pipe material is not shown on the Piping System Schedule or otherwise specified, the following materials shall be used:

<u>Pipe Size</u>	<u>Material</u>	<u>Type of Joint</u>	<u>Class/Design</u>	<u>Test Pressure</u>
4-in and larger	DIP	Flanged (Exposed)	Class 53	(1)
		Restrained (Buried)	Pressure Class 350	
Less than 4-in	PVC	Socket	Sch 80	(1)
(1) Test at 150 percent of normal operating pressure or 10 psi, whichever is greater.				

- C. Non-critical gravity lines such as drains, floor drains, roof drains, etc., do not typically require a pressure test

##### 1.03 VALVE SCHEDULES

- A. Performance Affidavits shall be required for all valves listed in the valve schedule(s). Performance Affidavits shall be provided in accordance with Section 11000, Equipment General Provisions and Section 01300, Submittals. All valves shall be tagged by the manufacturer according to the control valve designations listed in the Schedule.
- B. Valves not listed in the valve schedule(s) shall be manually operated, unless otherwise shown on the Drawings.

## PIPING SYSTEM SCHEDULE

PIPING SYSTEM SCHEDULE					
PIPE DESIGNATION	MATERIAL	TYPE OF JOINT	CLASS/DESIGN	RESTRAINT SYSTEM DESIGN <sup>(1)</sup> PRESSURE	TEST PRESSURE
D	PVC	SOCKET	Schedule 80		10 psi
FM	DIP	RESTRAINED (BURIED) FLANGED (EXPOSED)	Pressure Class 350	200 psi	150 psi
SS	PVC	PUSH-ON	SDR 26		

- (1) DESIGN PRESSURE SHALL BE USED TO DETERMINE THE SIZE, NUMBER, MATERIAL AND DIMENSIONS OF TABS AND THREADED-RODS FOR PIPING SPECIFIED OR SHOWN TO HAVE THREADED-RODS FOR THRUST RESTRAINT.
- (2) PROVIDE HEAT TRACING AND INSULATION AS SPECIFIED IN SECTION 15391 ON ALL EXTERIOR **EXPOSED** PIPING INDICATED.

## PIPING SYSTEM DESIGNATIONS

D	DRAIN
FM	FORCE MAIN
SS	SANITARY SEWER

## SECTION 16000

### BASIC ELECTRICAL REQUIREMENTS

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental, to the furnishing and installation of all electrical work as shown on the Drawings, and as specified in accordance with the provisions of the Contract Documents and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.
- B. Reference Section 17000, Control and Information System Scope and General Requirements for scope of work details as they relate to the Division 17 Subcontractor.
- C. The electrical scope of work for this project primarily includes, but is not limited to, the following:
  - 1. Furnish and install low voltage electrical power distribution equipment.
  - 2. Furnish and install all aboveground raceway systems including conduit, fittings, boxes, supports, and other pertinent components.
  - 3. Furnish and install all underground raceway systems including conduit, fittings, manholes, handholes and other pertinent components.
  - 4. Furnish and install all low voltage wire and cable resulting in a complete and operable electrical system.
  - 5. Furnish and install new lighting systems and wiring devices.
  - 6. Other electrical work as specified herein and indicated on the Drawings.
- D. All material and equipment must be the product of an established, reputable, and approved manufacturer; must be new and of first class construction; must be designed and guaranteed to perform the service required; and must bear the label of approval of the Underwriters Laboratories, Inc., where such approval is available for the product of the listed manufacturer as approved by the Engineer.

- E. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Engineer shall be furnished and installed at no additional cost to the Owner.
- F. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Engineer. The Contractor's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.
- G. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.
- H. All electrical components and systems, including electrical equipment foundations, shall be designed to resist operational forces as well as lateral sway and axial motion from seismic and thermal forces.

#### 1.02 EQUIPMENT LOCATION

- A. The Drawings show the general location of feeders, transformers, outlets, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting all of his work and shall arrange such work accordingly; furnishing such fittings, junction boxes, and accessories as may be required to meet such conditions. The Contractor shall refer to the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to ensure that proposed equipment will fit properly in spaces indicated.
- B. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings.

#### 1.03 LOCAL CONDITIONS

- A. The Contractor shall examine the site and become familiar with conditions affecting the work. The Contractor shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction. All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.
- B. The Contractor is responsible for coordinating all electric utility equipment installations with the serving electric utility. The Contractor shall furnish and install all electric utility equipment required by the electric utility to be installed by the Contractor whether specifically shown on the Drawings or not.

- C. The Contractor shall furnish and install the following electrical utility equipment as a minimum:
1. Primary and or secondary ductbank and manholes
  2. Metering equipment cabinets and/or bases
  3. Conduit and wire required from metering cabinet to metering current transformers and potential transformers.
  4. Secondary conductors
  5. Secondary terminations
- D. The electric utility will furnish and install the following equipment:
1. Primary conductors and terminations
- E. The Contractor is responsible for ensuring all electric utility equipment and construction installed by the Contractor is furnished and installed in accordance with the electric utility's design specifications and requirements. The Contractor is fully responsible for coordinating his scope of work with the electric utility. Any additional required electric utility construction or equipment not specified herein or shown on the Drawings shall be supplied by the Contractor at no additional cost to the Owner.
- F. The contact person at the serving electrical utility is:
- Electrical Engineering Office  
City of New Bern  
(252) 639-2823

#### 1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, Section 01300, Submittals and the requirements of the individual specification sections, the Contractor shall obtain from the equipment manufacturer and submit the following:
1. Shop Drawings
  2. Operation and Maintenance Manuals
  3. Spare Parts List
  4. Proposed Testing Methods and Reports of Certified Shop Tests.
  5. Reports of Certified Field Tests.
  6. Manufacturer's Representative's Certification.
- B. Submittals shall be sufficiently complete in detail to enable the Engineer to determine compliance with Contract requirements.

- C. Submittals will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components of that item for which the Contractor has provided no information.
- D. Some individual Division 16 specification sections may require a Compliance, Deviations, and Exceptions (CD&E) letter to be submitted. If the CD&E letter is required and shop drawings are submitted without the letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.
- E. Seismic support design for all nonstructural electrical components (conduit, raceways, freestanding equipment, etc.) shall be in accordance with all applicable federal, state and local building code requirements.

#### 1.05 APPLICABLE CODES AND REQUIREMENTS

##### A. Conformance

- 1. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the following:
  - a. Insurance Rating Organization having jurisdiction
  - b. The serving electrical utility company
  - c. The currently adopted edition of the National Electrical Code (NEC)
  - d. The National Electric Manufacturers Association (NEMA)
  - e. The Institute of Electrical and Electronic Engineers (IEEE)
  - f. The Insulated Cable Engineers Association (ICEA)
  - g. The American Society of Testing Materials (ASTM)
  - h. The American National Standards Institute (ANSI)
  - i. The requirements of the Occupational Safety Hazards Act (OSHA)
  - j. The National Electrical Contractors Association (NECA) Standard of Installation
  - k. National Fire Protection Association (NFPA)
  - l. International Electrical Testing Association (NETA)



- m. All other applicable Federal, State and local laws and/or ordinances.
- 2. All material and equipment shall bear the inspection labels of Underwriters Laboratories, Inc., if the material and equipment is of the class inspected by said laboratories.

B. Nonconformance

- 1. Any paragraph of requirements in these Specifications, or Drawings, deviating from the rules, requirements and Specifications of the above organizations shall be invalid and their (the above organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements and specifications as set forth above. Any additional work or material necessary for adherence will not be allowed as an extra, but shall be included in the Bid. Ignorance of any rule, requirement, or Specification shall not be allowed as an excuse for nonconformity. Acceptance by the Engineer does not relieve the Contractor from the expense involved for the correction of any errors which may exist in the drawings submitted or in the satisfactory operation of any equipment.

C. Certification

- 1. Upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the National Board of Fire Underwriters or similar inspection organization having jurisdiction and shall deliver same to the Engineer and the Owner.

1.06 PERMITS AND INSPECTIONS

- A. The Contractor shall reference the General Conditions and Section 01010, Summary of Work.

1.07 TEMPORARY LIGHTING AND POWER

- A. The Contractor shall reference the General Conditions and Section 01510, Temporary Utilities.

1.08 TESTS

- A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance, overloads, and short circuits. Tests shall be made with and to the satisfaction of the Owner and Engineer.
- B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Owner. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five (5) times.
- C. Refer to each individual specification section for detailed test requirements.
- D. The Contractor shall complete the installation and field testing of the electrical installation at least two (2) weeks prior to the start-up and testing of all other equipment. During the

period between the completion of electrical installation and the start up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.

- E. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, manpower and scheduling information for the approval by the Engineer. In addition, the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of other systems.

#### 1.09 INFRARED INSPECTION

- A. Just prior to the final acceptance of a piece of equipment, the Contractor shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment terminations.
- B. The infrared inspection shall apply to all new equipment and existing equipment that is in any way modified under this Contract. All heating problems detected with new equipment furnished and installed under the Scope of this Contract shall be corrected by the Contractor. All problems detected with portions of existing equipment modified under this Contract shall also be corrected by the Contractor.
- C. Any issues detected with portions of existing equipment that were not modified under this Contract are not the responsibility of the Contractor. Despite the Contractor not being held responsible for these problems, the Contractor shall report them to the Owner and Engineer immediately for resolution.
- D. The infrared inspection report shall include both digital and IR pictures positioned side by side. Both the digital and IR pictures shall be clear and high quality. Fuzzy, grainy, or poorly illuminated pictures are not acceptable. The IR picture shall be provided with a temperature scale beside it, and an indication of the hot spot temperature in each picture. Reports shall be furnished in a 3-ring binder, with all pages printed in full color, with equipment assemblies separated by tabs.

#### 1.10 PROTECTIVE DEVICE SETTING AND TESTING

- A. The Contractor shall provide the services of a field services organization to adjust, set, calibrate and test all protective devices in the electrical system. The organization shall be a subsidiary of or have a franchise service agreement with the electrical equipment manufacturer. The qualifications of the organization and resumes of the technicians as well as all data forms to be used for the field testing shall be submitted.
- B. All protective devices in the electrical equipment shall be set, adjusted, calibrated and tested in accordance with the manufacturers' recommendations, the coordination study, and best industry practice.
- C. Proper operation of all equipment associated with the device under test and its compartment shall be verified, as well as complete resistance, continuity and polarity tests of power, protective and metering circuits. Any minor adjustments, repairs and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.
- D. All solid state trip devices shall be checked and tested for setting and operation using manufacturers recommended test devices and procedures.

- E. Circuit breakers and/or contactors associated with the above devices shall be tested for trip and close functions with their protective device.
- F. When completed, the Contractor shall provide a comprehensive report for all equipment tested indicating condition, readings, faults and/or deficiencies in same. Inoperative or defective equipment shall be brought immediately to the attention of the Engineer.
- G. Prior to placing any equipment in service, correct operation of all protective devices associated with this equipment shall be demonstrated by field testing under simulated load conditions.

#### 1.11 POWER SYSTEM STUDIES

- A. The Engineer will provide the Power System studies to the firm providing the protective device setting and testing services. The Contractor shall notify the Engineer six (6) weeks in advance of the scheduled date for the protective device setting and testing. The testing firm shall submit to the Engineer a tabulated listing of all protective devices requiring setting six (6) weeks prior to the setting and testing date. This table shall include the protective device manufacturer, model number, ampere rating (if applicable), instrument transformer ratios, and all other required information.

#### 1.12 SCHEDULES AND FACILITY OPERATIONS

- A. Since the equipment testing required herein shall require that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the Engineer for review and approval one (1) month prior to any work beginning. When testing has been scheduled, the Engineer must be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of facility equipment must be coordinated with the Owner/Engineer so as not to affect proper facility operations.
- B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a facility emergency arise. In addition, should an emergency condition occur during testing, at the request of the Owner, the equipment shall be placed back in service immediately and turned over to Owner personnel.
- C. In the event of accidental shutdown of Owner equipment, the Contractor shall notify Owner personnel immediately to allow for an orderly restart of affected equipment.
- D. Maintaining the operation of these facilities during the duration of the construction period is essential and required. The Contractor shall furnish and install temporary equipment as required to maintain facility operation. Reference Section 01520 of the Specifications for construction sequencing and specific operational constraint information.

#### 1.13 MATERIALS HANDLING

- A. Materials arriving on the job site shall be stored in such a manner as to keep material free of rust and dirt and so as to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material will be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat.

Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Engineer. If space heaters are provided in a piece of electrical equipment, they shall be temporarily connected to a power source during storage. The Contractor shall store equipment and materials in accordance with Section 01550, Site Access and Storage.

#### 1.14 WARRANTIES

- A. Unless otherwise specified in an individual specification section, all equipment and electrical construction materials furnished and installed under Division 16 shall be provided with a warranty in accordance with the requirements of Section 11000, Equipment General Provisions and the General Conditions.

#### 1.15 TRAINING

- A. Unless otherwise specified in an individual specification section, all training for equipment furnished and installed under Division 16 shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

### PART 2 – PRODUCTS

#### 2.01 PRODUCT REQUIREMENTS

- A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.
- B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.
- C. All equipment and materials shall be new, unless indicated or specified otherwise.
- D. The Contractor shall submit proof if requested by the Engineer that the materials, appliances, equipment, or devices that are provided under this Contract meet the requirements of Underwriters Laboratories, Inc., in regard to fire and casualty hazards. The label of or listing by the Underwriters Laboratories, Inc., will be accepted as conforming to this requirement.

#### 2.02 SUBSTITUTIONS

- A. Unless specifically noted otherwise, any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition. The Contractor, in such cases

may, at his option use any article, device, product, material, fixture, or item of equipment which in the judgment of the Engineer, expressed in writing, is equal to that specified.

## 2.03 CONCRETE

- A. The Contractor shall furnish all concrete required for the installation of all electrical work, Concrete shall be Class A unless otherwise specified. Concrete and reinforcing steel shall meet the appropriate requirements of Division 3 of the Specifications.
- B. The Contractor shall provide concrete equipment pads for all free standing electrical apparatus and equipment located on new or existing floors or slabs. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches high unless otherwise indicated on the Drawings and shall conform to standard detail for equipment pads shown on the Contract Drawings. Equipment pads shall not have more than 3" excess concrete beyond the edges of the equipment.
- C. The Contractor shall provide concrete foundations for all free standing electrical apparatus and equipment located outdoors or where floors or slabs do not exist and/or are not or provided by others under this Contract. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of the foundations. Equipment foundations shall be constructed as detailed on the Drawings or if not detailed on the Drawings shall be 6 inches thick minimum reinforced with #4 bars at 12-inch centers each way placed mid-depth. Concrete shall extend 6 inches minimum beyond the extreme of the equipment base and be placed on a compacted stone bed (#57 stone or ABC) 6 inches thick minimum.

## PART 3 – EXECUTION

### 3.01 CUTTING AND PATCHING

- A. Coordination
  - 1. The Work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.
- B. Damage
  - 1. The Contractor shall perform all chasing, channeling, drilling and patching necessary to the proper execution of his Contract. Any damage to the building, structure, or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Engineer's judgment, the repair of damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at his own expense.
- C. Existing Equipment
  - 1. Provide a suitable cover or plug for openings created in existing equipment as the result of work under this Contract. For example, provide round plugs in equipment

enclosures where the removal of a conduit creates a hole and the enclosure. Covers and plugs shall maintain the NEMA rating of the equipment enclosure. Covers and plugs shall be watertight when installed in equipment located outdoors.

### 3.02 EXCAVATION AND BACKFILLING

- A. The Contractor shall perform all excavation and backfill required for the installation of all electrical work. All excavation and backfilling shall be in complete accordance with the applicable requirements of Division 2.

### 3.03 CORROSION PROTECTION

- A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

- - END OF SECTION - -

## SECTION 16111

### CONDUIT

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein, indicated on the Drawings, and as required.
- B. Requirements for conduit clamps, support systems, and anchoring are not included in this Section. Reference Section 16190, Electrical Supporting Devices, for these requirements.
- C. Reference Section 16000, Basic Electrical Requirements.

##### 1.02 CODES AND STANDARDS

- A. Conduits and conduit fittings shall be designed, manufactured, and/or listed to the following standards as applicable:
  - 1. American National Standards Institute (ANSI)
    - a. ANSI B1.20.1 – Pipe Threads, General Purpose
    - b. ANSI C80.1 – Electrical Rigid Steel Conduit
    - c. ANSI C80.5 – Electrical Rigid Aluminum Conduit
    - d. ANSI FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
  - 2. Underwriters Laboratories (UL)
    - a. UL 6 - Electrical Rigid Metal Conduit-Steel
    - b. UL 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel
    - c. UL 467 – Grounding and Bonding Equipment
    - d. UL 514B – Conduit, Tubing, and Cable Fittings
    - e. UL 651 – Standard for Schedule 40 and 80 Conduit and Fittings
    - f. UL 1203 - Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations

- g. UL 1479 – Standard for Fire Tests of Penetration Fire Stops
- h. UL 1660 – Liquid-tight Flexible Nonmetallic Conduit
- 3. National Electrical Manufacturer's Association (NEMA)
  - a. NEMA RN 1 – PVC Externally Coated Galvanized Rigid Steel Conduit
  - b. NEMA TC-2 – Electrical PVC Conduit
  - c. NEMA TC-3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing

B. Others

- 1. ACI-318 – Building Code Requirements for Structural Concrete

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300 – Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
  - 1. Product data sheets for conduits and fittings.
  - 2. Conduit identification methods and materials.
  - 3. Evidence of training for all personnel that will install PVC coated rigid metal conduit.

1.05 DEFINITIONS

- A. Conduits are categorized by the circuit type of the wiring to be installed inside. Conduits are defined as follows:
  - 1. Power Conduits – Conduits that carry AC or DC power wiring from a source to a load. Conduits that carry lighting and receptacle wiring.



2. Control Conduits – Conduits that carry AC or DC discrete control wiring between devices and/or equipment. Conduits that carry fiber optic cables between devices and/or equipment.
3. Instrumentation Conduits – Conduits that carry AC or DC analog signal wiring between devices and/or equipment.

## PART 2 – PRODUCTS

### 2.01 GENERAL

- A. Conduit and conduit fitting products are specified in the text that follows this article. Reference Part 3 herein for the application, uses and installation requirements of these conduits and conduit fittings.
- B. All metallic conduit fittings shall be UL 514B and UL 467 Listed, and constructed in accordance with ANSI FB 1. All metallic conduit fittings for use in Class I Division I hazardous areas shall be UL 1203 Listed. All non-metallic fittings shall be UL 651 Listed and constructed in accordance with NEMA TC-3.
- C. Flexible conduit couplings for use in Class I Division I hazardous areas shall have threaded stainless steel end fittings and a flexible braided core. Flexible braid shall be constructed of stainless steel where available in the conduit trade size required for the application. Where stainless steel braid is not available, the braid shall be provided with a PVC coating. No other braid types or materials are acceptable.
- D. Where threading is specified herein for conduit fitting connections, the fittings shall be manufactured to accept conduit that is threaded to ANSI B1.20.1 requirements.
- E. Conduit expansion fittings for all conduit materials of construction shall be capable of 4 inches of movement along the axis of the conduit for trade sizes 2 inches or less. Expansion fittings shall be capable of 8 inches of movement along the axis of the conduit for trade sizes greater than 2 inches.
- F. Conduit deflection fittings for all conduit materials of construction shall be provided with a flexible neoprene outer jacket that permits up to  $\frac{3}{4}$  inch of expansion/contraction along the axis of the conduit as well as up to  $\frac{3}{4}$  inch of parallel misalignment between the conduit axes. Outer jacket shall be secured to the conduit hubs by stainless steel clamps.
- G. Conduit seals shall either be Listed and labeled for 40% fill, or conduit reducing fittings and a trade size larger conduit seal shall be provided to achieve 25% or less fill within the seal. Percentage fill calculation shall be based on the conductors to be installed. Conduit seals shall be provided with breathers and/or drains where required by the NEC.
- H. Conduit insulating bushings shall be constructed of plastic and shall have internal threading.
- I. Additional conduit and conduit fitting requirements are specified in the articles that follow based on the specific conduit material of construction to be used.

## 2.02 RIGID GALVANIZED STEEL (RGS) CONDUIT AND ASSOCIATED FITTINGS

### A. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside, and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1, and shall be UL 6 Listed.
2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

### B. Conduit Bodies for use with Rigid Galvanized Steel

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit bodies shall have integral threaded conduit hubs.
2. Conduit bodies for Class I Division I hazardous areas shall be provided with integrally threaded covers constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish.
3. Conduit bodies for all other areas shall be provided with covers that are affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Covers shall be provided with matching gasket.

### C. Conduit Couplings, Nipples, and Unions for use with Rigid Galvanized Steel

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel. Split-type couplings that use compression to connect conduits are not acceptable.
2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish.

### D. Conduit Expansion and Deflection Fittings for use with Rigid Galvanized Steel

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Expansion and deflection fittings shall have threaded conduit connections.
2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

### E. Conduit Seals for use with Rigid Galvanized Steel

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit seals shall have threaded conduit connections.

F. Conduit Termination Fittings for use with Rigid Galvanized Steel

1. Conduit hubs shall be constructed of stainless steel and shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.
2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts with integral gasket or seal are not acceptable. Locknuts shall have integral bonding screw where required for proper bonding.
3. Conduit bonding bushings shall be constructed of zinc plated malleable iron. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.03 RIGID NONMETALLIC CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be Schedule 40 or 80 (dependent on application) polyvinyl chloride (PVC) construction, manufactured in accordance with NEMA TC-2, UL 651 Listed, and suitable for conductors with 90 degree C insulation.

B. Conduit Bodies for use with Rigid Nonmetallic Conduit

1. Conduit bodies shall be constructed of PVC. Conduit hubs shall be integral to the conduit body and shall be smooth inside to accept a glued conduit connection.
2. Conduit body shall be provided with cover that is affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings and Unions for use with Rigid Nonmetallic Conduit

1. Conduit couplings and unions shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

D. Conduit Expansion and Deflection Fittings for use with Rigid Nonmetallic Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

E. Conduit Termination Fittings for use with Rigid Nonmetallic Conduit

1. Conduit hubs shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. Hubs shall have external threads and an accompanying PVC locknut, and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts constructed of PVC and locknuts with integral gasket or seal are not acceptable.
3. Conduit end bells shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. End bell shall have a smooth inner surface that curves outward towards the edge of the fitting.

## 2.04 PVC COATED RIGID GALVANIZED STEEL CONDUIT AND ASSOCIATED FITTINGS

### A. General

1. Where an external coating of polyvinyl chloride (PVC) is specified for conduit and fittings, the coating shall be 40 mil (minimum) thickness. Where an internal coating of urethane is specified for conduit and fittings, the coating shall be 2 mil (minimum) thickness.
2. All conduit fittings shall have a sealing sleeve constructed of PVC which covers all connections to conduit. Sleeves shall be appropriately sized so that no conduit threads will be exposed after assembly.

### B. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside, and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1, and shall be UL 6 Listed.
2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.
3. Conduit shall be coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit shall be manufactured in accordance with NEMA RN-1.

### C. Conduit Bodies for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit bodies shall have integral threaded conduit hubs.
2. Conduit bodies for Class I Division I hazardous areas shall be provided with integrally threaded covers constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.
3. Conduit bodies for all other areas shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Covers shall be affixed in place by stainless steel screws which thread directly into the conduit body and have a plastic encapsulated

head. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

D. Conduit Couplings, Nipples, and Unions for use with PVC Coated Rigid Galvanized Steel Conduit

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Split-type couplings that use compression to connect conduits are not acceptable.
2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

E. Conduit Expansion and Deflection Fittings for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Expansion and deflection fittings shall have threaded conduit connections.
2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

F. Conduit Seals for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit seals shall have threaded conduit connections.

G. Conduit Termination Fittings for Use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit hubs shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Hubs shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.
2. Conduit bonding bushings shall be constructed of zinc plated malleable iron which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

## 2.05 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Trade size 1-1/4 inch and smaller conduits shall be provided with an integrally woven copper bonding strip.
2. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 360 Listed.

B. Conduit Termination Fittings for use with LFMC

1. Conduit termination fittings shall be constructed of either 304 stainless steel or an electro-galvanized malleable iron alloy which is coated on the exterior with a 40 mil (minimum) PVC jacket and coated on the interior with a 2 mil (minimum) layer of urethane. PVC coated fittings shall have a sealing sleeve constructed of PVC which covers the connection to conduit.
2. Termination fittings shall have a threaded end with matching locknut and sealing ring for termination to equipment, and shall have an integral external bonding lug where required for proper bonding. Termination fittings shall have a plastic insulated throat and shall be watertight when assembled to the conduit and equipment.

## 2.06 LIQUID TIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be constructed of rigid polyvinyl chloride (PVC), fabricated to provide flexibility. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 1660 Listed.

B. Conduit Termination Fittings for use with LFNC

1. Conduit termination fittings shall be constructed PVC and shall have a threaded end with matching locknut and sealing ring for termination to equipment. Termination fittings shall be watertight when assembled to the conduit and equipment.

## 2.07 CONDUIT BENDS

- A. Rigid conduit bends, both factory fabricated and field fabricated, shall meet the same requirements listed in the articles above for the respective conduit type and material of construction.

- B. Conduit bend radii for standard radius bends shall be no less than as follows:

TRADE SIZE (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
MIN. RADIUS (inches)	4-1/2	5-3/4	7-1/4	8-1/4	9-1/2	10-1/2	13	15	16	24	30

C. Conduit bend radii for long radius bends shall be no less than as follows:

TRADE SIZE (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
MIN. RADIUS (inches)	N/A	12	18	24	30	30	36	36	48	48	60

## 2.08 MISCELLANEOUS

### A. Conduit Periphery Sealing

1. The sealing of the exterior surface of conduits to prevent water and/or air from passing around the conduit periphery from one space to another (where required) shall be through the use of one of the following:
  - a. A conduit sleeve and pressure bushing sealing system. Acceptable products are FSK by OZ-GEDNEY, Link-Seal by Crouse-Hinds, or Engineer approved equal.
  - b. A conduit sleeve that is two trade sizes larger than the conduit being sealed, with 2-hour fire rated UL 1479 Listed caulk filling the entire void between the conduit and sleeve. This method is only suitable for penetrations in non-fire rated walls and floors between spaces within buildings. This method shall not be used for the sealing of conduits leaving a building and/or structure.
2. Conduit penetrations through fire-rated walls and floors shall be made with an approved UL 1479 Listed product specifically intended for the trade size of the conduit.

### B. Primer and Cement

1. Nonmetallic conduit shall be cleaned with primer and connected to fittings with the manufacturer's recommended cement that is labeled Low VOC.

### C. Galvanizing Compounds

1. Galvanizing compounds for field application shall be the cold-applied type, containing no less than 93% pure zinc.

### D. Conduit Interior Sealing

1. The sealing of the inside of conduits against water ingress shall be achieved through the use of one of the following:
  - a. Two-part expanding polyurethane foam sealing compound, dispensed from a single tube which mixes the two parts as it is injected into the conduit. Expanding foam shall be compatible with the conduit material of construction as well as the outer jacket of the cables in the conduit. Acceptable products are Q-Pak 2000 by Chemque, FST by American Polywater Corporation, or Hydra-seal S-60 by Duraline.

- b. Inflatable bag that provides seal around cables and around inside diameter of conduit. Provide appropriate quantity of additional fittings for applications with three or more cables in the conduit to be sealed. Acceptable products are Rayflate by Raychem, or Engineer approved equal. This sealing method is only applicable to conduits trade size 2 inch and larger.
  - c. Neoprene sealing ring provided with the required quantity and diameter of holes to accommodate the cables in each conduit. Sealing ring shall be compressed by two stainless steel pressure plates. Acceptable products are type CSB by OZ-GEDNEY, or Engineer approved equal. This sealing method is only applicable to metallic conduits containing 4 or less cables.
2. The use of aerosol-based expanding foam sealants or any other method of sealing against water ingress not listed above is not acceptable.

E. Pull Rope

- 1. Pull ropes for empty and/or spare conduits shall be woven polyester, 1/2 inch wide, with a minimum tensile strength of 1250 lbs.
- 2. Pull ropes for the Contractors use in installing conductors shall be the size and strength required for the pull, and shall be made of a non-metallic material.

### PART 3 – EXECUTION

#### 3.01 GENERAL

- A. Minimum trade size for all rigid conduits shall be 3/4 inch in exposed applications and 1 inch in embedded applications. Conduits installed within ductbanks shall be allowed to be increased in size to trade size 2 inch, at the Contractor's option, to accommodate the saddle size of the ductbank spacers. However, no combining of circuits shall be allowed in the larger conduits.
- B. Minimum trade size for flexible conduits (where specifically allowed herein) shall be 1/2 inch in all applications.
- C. Conduit routing and/or homeruns within structures is not shown on the Drawings. Conduits shall be installed concealed wherever practical and within the limitations specified herein. All other conduits not capable of being installed concealed shall be installed exposed.
- D. Empty and/or spare conduits shall be provided with pull ropes which have no less than 12 inches of slack at each end.
- E. Nonmetallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, cleaned of debris, and primer shall be applied to ready each joint for fusing. Conduits shall then be fused together with the conduit manufacturer's approved cement compound.
- F. Metallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, be cleaned of all debris



and be de-burred, then threaded. Conduit threading performed in the field shall be  $\frac{3}{4}$  inch per foot tapered threads in accordance with ANSI B1.20.1.

- G. Conduits shall be protected from moisture, corrosion, and physical damage during construction. Install dust-tight and water-tight conduit fittings on the ends of all conduits immediately after installation and do not remove until conductors are installed.
- H. Conduits shall be installed to provide no less than 12 inches clearance from pipes that have the potential to impart heat upon the conduit. Such pipes include, but are not limited to, hot water pipes, steam pipes, exhaust pipes, and blower air pipes. Clearance shall be maintained whether conduit is installed in parallel or in crossing of pipes.
- I. Where non-metallic instrumentation conduits are installed exposed, the following clearances to other conduit types shall be maintained:
  - 1. Instrumentation conduits installed parallel to conduits with conductors energized at 480V or above shall be 18 inches.
  - 2. Instrumentation conduits installed parallel to conduits with conductors energized at 240V and below shall be 12 inches.
  - 3. Instrumentation conduits installed at right angles to conductors energized at 480V and below shall be 6 inches.
  - 4. Instrumentation conduits installed at right angles to conductors energized at voltages above 480V shall be 12 inches.
- J. Where conduit fittings do not include an integral insulated bushing, an insulated bushing shall be installed at all conduit termination points.
- K. Conduits which serve multi-section equipment shall be terminated in the section where wiring terminations will be made.
- L. Conduits shall not penetrate the floors or walls inside liquid containment areas without specific written authorization from the Engineer. Liquid containment areas are indicated on the Drawings.
- M. All field fabricated threads for rigid galvanized steel conduit shall be thoroughly coated with two coats of galvanizing compound, allowing at least two minutes to elapse between coats for proper drying.
- N. The appropriate specialized tools shall be used for the installation of PVC coated conduit and conduit fittings. No damage to the PVC coating shall occur during installation. Conduit and conduit fittings with damaged PVC coating shall be replaced at the Contractor's cost. The use of PVC coating touch-up compounds is not permitted.
- O. Conduits which emerge from within or below concrete encasement shall be PVC coated rigid galvanized steel in accordance with Standard Detail 1611102 where the conduit is not protected by an equipment enclosure that surrounds the conduit on all sides at the point where it emerges from the encasement.
- P. Aluminum conduits shall not be installed in direct contact with concrete surfaces. Where aluminum conduits are routed along concrete surfaces, they shall be installed with one-

hole electro-galvanized malleable iron alloy straps with matching clamp-backs to space the conduit ¼ inch away from concrete surface. Where aluminum conduit passes through concrete, CMU or brick walls, the penetration shall be made such that the aluminum conduit does not come in contact with concrete, CMU, brick or mortar.

### 3.02 CONCEALED AND EMBEDDED CONDUITS

- A. Conduits are permitted to be installed concealed and/or embedded with the following requirements:
  - 1. Conduits shall not be installed horizontally when concealed within CMU walls, only vertical installation is acceptable.
  - 2. Conduits installed embedded within concrete floors or walls shall be located so as not to affect the designed structural strength of the floor or wall. Embedded conduits shall be installed in accordance with Standard Detail 0331604 and ACI-318.
  - 3. Where conduit bends emerge from concrete embedment, none of the curved portion of the bend shall be visible. Only the straight portion of the bend shall be visible.
  - 4. Where multiple conduits emerge from concrete embedment or from concealment below a concrete floor, ample clear space shall be provided between conduits to allow for the appropriate and required conduit termination fittings to be installed.
  - 5. Conduits installed embedded within concrete encasement of any kind shall be installed such that conduit couplings for parallel conduits are staggered so that they are not side by side.
- B. Conduits are NOT permitted to be installed concealed and/or embedded for the following situations:
  - 1. Conduits shall not be installed embedded within any water-bearing floors or walls. Conduits shall not be installed embedded within any liquid containment area floors or walls.
  - 2. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to Class I and II hazardous areas (Division I and Division II).
  - 3. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to indoor Type 1 or Type 2 chemical storage/transfer areas.

### 3.03 CONDUIT USES AND APPLICATIONS

- A. Rigid Conduit
  - 1. Rigid conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

<b>RIGID CONDUIT FOR NON-HAZARDOUS AREAS</b>		
<b><u>INSTALLATION AREA DESIGNATION/ SCENARIO</u></b>	<b><u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u></b>	
	<b>Power and Control</b>	<b>Instrumentation</b>
Exposed in outdoor areas	PVC coated rigid galvanized steel conduit	Same as Power and Control
Concealed within underground direct-bury or concrete-encased ductbanks	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within non-elevated (i.e. "slab-on-grade" construction) concrete slabs	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within elevated concrete slabs	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs (within earth or fill material)	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Emerging from concealment within or below a concrete floor and transitioning to exposed conduit (Reference Detail 1611102)	PVC coated rigid galvanized steel conduit	Same as Power and Control

2. Rigid conduit for hazardous areas shall be furnished and installed in the materials of construction as follows:

<b>RIGID CONDUIT FOR HAZARDOUS AREAS</b>		
<b><u>INSTALLATION AREA HAZARD/SCENARIO</u></b>	<b><u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u></b>	
	<b>Power and Control</b>	<b>Instrumentation</b>
Exposed in Class I and II areas (Division I and Division II)	PVC coated rigid galvanized steel conduit	Same as Power and Control
Concealed within concrete slabs in Class I and II areas (Division I and Division II)	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs (within earth or fill material) in Class I and II areas (Division I and Division II)	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs encased in at least two inches of concrete and buried 24 inches below top of slab in Class I Division I areas	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit

3. The tables for the materials of construction for rigid conduits are intended to exhaustively cover all possible scenarios and installation areas under this Contract. However, if a scenario or installation area is found that is not explicitly governed by these tables, it shall be assumed for bid purposes that the conduit material of construction is to be rigid galvanized steel. This discrepancy shall be brought to the attention of the Engineer (in writing) immediately for resolution.

B. Conduit Bends

1. All conduit bends shall be the same material of construction as the rigid conduit listed in the tables above, with the following exceptions:
  - a. All 90 degree bends or combinations of adjacent bends that form a 90 degree bend where concealed within concrete or below a concrete slab shall be rigid galvanized steel.
2. Field fabricated bends of metallic conduit shall be made with a bending machine and shall have no kinks. Field fabricated standard radius and long radius bends shall have minimum bending radii in accordance with the associated tables in Part 2 herein.
3. Field bending of non-metallic conduits is not acceptable, factory fabricated bends shall be used.
4. Long radius bends shall be furnished and installed for the following specific applications, all other bends shall be standard radius:
  - a. Where specifically indicated on the Drawings.

C. Flexible Conduit

1. Flexible conduit shall only be installed for the limited applications specified herein. Flexible conduit shall not be installed in any other application without written authorization from the Engineer. Acceptable applications are as follows:
  - a. Connections to motors and engine-generator sets (and similar vibrating equipment)
  - b. Connections to solenoid valves and limit switches
  - c. Connections to lighting fixtures installed in suspended ceilings
  - d. Connections to lighting transformers
  - e. Connections to pre-fabricated equipment skids
  - f. Connections to HVAC equipment
  - g. Connections to instrument transmitters and elements
  - h. Where specifically indicated in the Standard Details
2. Flexible conduit length shall be limited to three (3) feet, maximum. Flexible conduit shall not be installed buried or embedded within any material.
3. Flexible conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

<b>FLEXIBLE CONDUIT FOR NON-HAZARDOUS AREAS</b>		
<b><u>INSTALLATION AREA DESIGNATION/SCENARIO</u></b>	<b><u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u></b>	
	<b>Power and Control</b>	<b>Instrumentation</b>
Exposed in outdoor areas	Liquid-tight flexible metal conduit	Same as Power and Control

4. For Class I Division I hazardous areas, the NEC does not permit the installation of flexible conduit. In lieu of flexible conduit in these areas, flexible conduit couplings shall be installed as specified in Part 2 herein. Flexible conduit for all other hazardous areas shall be furnished and installed in the materials of construction as follows:

<b>FLEXIBLE CONDUIT FOR HAZARDOUS AREAS</b>		
<b><u>INSTALLATION AREA HAZARD/SCENARIO</u></b>	<b><u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u></b>	
	<b>Power and Control</b>	<b>Instrumentation</b>
Exposed in Class I Division II areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in Class II (Division I and Division II) areas	Liquid-tight flexible metal conduit	Same as Power and Control

### 3.04 CONDUIT FITTING USES AND APPLICATIONS

#### A. General

1. Conduit fittings shall be furnished and installed in the materials of construction as indicated in Part 2, herein. Conduit fitting materials of construction are dependent on the material of construction used for the associated conduit.
2. Conduit fittings shall be provided in the trade size and configuration required to suit the application.

#### B. Conduit Bodies

1. Conduit bodies shall be installed where wire pulling points are desired or required, or where changes in conduit direction or breaking around beams is required.
2. Where conduit bodies larger than trade size 2 inches are intended to be used as a pull-through fitting during wire installation, oversized or elongated conduit bodies shall be used. Oversized or elongated conduit bodies shall not be required if the conduit body is intended to be used as a pull-out point during wire installation.

#### C. Conduit Nipples and Unions

1. Conduits with running threads shall not be used in place of 3-piece couplings (unions) or close nipples. After installation of a conduit fitting of any kind, there shall be no more than ¼ inch of exposed threads visible. Factory fabricated all-thread nipples

may be used between adjacent enclosures, however, the same restriction applies regarding the length of exposed threads that are visible.

D. Conduit Expansion and Deflection Fittings

1. Conduit expansion fittings shall be installed where required by the NEC and where indicated on the Drawings. Expansion fittings shall also be installed for exposed straight metallic conduit runs of more than 75 feet, in both indoor and outdoor locations. Expansion fittings for runs of non-metallic conduit shall be installed in accordance with the NEC.
2. Conduit deflection fittings shall be installed where required by the NEC and where conduits are installed (exposed and concealed) across structural expansion joints.

E. Conduit Seals

1. Conduit seals shall be installed for conduits installed within or associated with hazardous areas and other areas as required by the NEC. In addition, conduit seals shall also be furnished and installed as follows:
  - a. All conduits entering or leaving enclosed areas which store or distribute chlorine gas.
  - b. All conduits entering or leaving enclosed areas which store or distribute sulfur dioxide gas.

F. Conduit Termination Fittings

1. Where conduits terminate at enclosures with a NEMA 4, 4X, or 3R rating and the enclosure does not have integral conduit hubs, an appropriately sized watertight conduit hub shall be installed to maintain the integrity of the enclosure. The use of locknuts with integral gasket in lieu of watertight conduit hubs is not acceptable.
2. Where conduits terminate at enclosures that do not require conduit hubs, a two-locknut system shall be used to secure the conduit to the enclosure. One locknut shall be installed on the outside of the enclosure, and the other inside, drawn tight against the enclosure wall. The locknut on the interior of the enclosure shall be the type with integral bonding lug, or a conduit bonding bushing may be used in place of the locknut.
3. Conduits shall not be installed such that conduit fittings penetrate the top of any enclosure located outdoors, except in cases where specifically required by the serving electric utility. Conduits which serve outdoor equipment or an enclosure from above shall instead be routed into the side of the enclosure at the bottom. The conduit termination fitting shall be provided with a conduit drain to divert moisture from the raceway away from the enclosure.

3.05 MISCELLANEOUS

A. Conduit Periphery Sealing

1. All conduit penetrations through exterior walls shall be sealed around the periphery using the appropriate products specified in Part 2 herein to prevent air and/or water entry into the structure.
2. All conduit penetrations through interior walls and floors shall be sealed through the use of with conduit sleeves and caulk as specified in Part 2 herein. Alternatively, mortar may be used to seal around the conduit periphery.
3. Conduit penetrations through fire-rated walls as floors shall be made with the appropriate fire rated penetration product.

B. Conduit Interior Sealing

1. All conduits (including spares) entering a structure below grade shall be sealed on the interior of the conduit against water ingress. Sealing shall be at an accessible location in the conduit system located within the building structure and shall be via one of the methods specified in Part 2 herein. If conduit sealing cannot be achieved at an accessible location within the building structure, sealing shall be placed in the conduits in the nearest manhole or handhole outside the structure.

### 3.06 CONDUIT IDENTIFICATION

- A. Exposed conduits shall be identified at the source, load, and all intermediate components of the raceway system. Examples of intermediate components include but are not limited to junction boxes, pull boxes, and disconnect switches. Identification shall be by means of an adhesive label with the following requirements:
1. Labels shall consist of an orange background with black text. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.
  2. In addition, at the source end of the conduit, a second line of text shall be included to indicate the load equipment name. This second line shall consist of the word "TO:" and the text in the 'TO' column of the conduit and wire schedule (e.g. TO: Pump Control Panel). At the load end of the conduit, a second line of text shall be included to indicate the source equipment name. This second line shall consist of the word "FROM:" and the text in the 'FROM' column of the conduit and wire schedule (e.g. FROM: LP-MDPS). This requirement applies only to the source and load ends of the conduit, and not anywhere in between.
  3. For conduits trade sizes 3/4 inch through 1-1/2 inch, the text shall be a minimum 18 point font. For conduits trade size 2 inch and larger, the text shall be a minimum 24 point font.
  4. Label height shall be 3/4 inch minimum, and length shall be as required to fit required text. The label shall be installed such that the text is parallel with the axis of the conduit. The label shall be oriented such that the text can be read without the use of any special tools or removal of equipment.
  5. Labels shall be installed after each conduit is installed and, if applicable, after painting. Labels shall be printed in the field via the use of a portable label printing system. Handwritten labels are not acceptable.

6. Labels shall be made of permanent vinyl with adhesive backing. Labels made of any other material are not acceptable.
- B. Conduits that are not exposed but installed beneath free standing equipment enclosures shall be identified by means of a plastic tag with the following requirements:
    1. The tag shall be made of white Tyvek material, and have an orange label with black text, as described above, adhered to it. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.
    2. The tag shall be affixed to the conduit by means of a nylon cable tie. The tag shall be of suitable dimensions to achieve a minimum text size of 18 points.
  - C. Conduits for lighting and receptacle circuits shall not require identification.
  - D. Any problems or conflicts with meeting the requirements above shall immediately be brought to the attention of the Engineer for a decision.

### 3.07 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
  1. All conduit installed below grade or concrete encased shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of a suitable pulling rope.

### 3.08 TRAINING OF INSTALLATION PERSONNEL

- A. All Contractor personnel that install PVC coated RGS conduit shall be trained by the PVC coated RGS conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract to be considered valid. Contractor personnel not trained within this timeframe shall not be allowed to install coated conduit, or shall be trained/re-trained as required prior to commencement of conduit installation.

- - END OF SECTION - -



SECTION 16118  
UNDERGROUND ELECTRICAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install underground duct systems, electric manholes, and electric handholes as specified herein and as indicated on the Drawings. The work shall be complete and shall include excavation, concrete construction, backfilling, and all materials, items, and components required for a complete system.
- B. The provisions of this Division are applicable to all underground conduit work. All work shall be coordinated with that of the various utility companies and other Contractors. The Contractor shall adhere to all utility company requirements including the serving electric utility.
- C. Reference Section 16000, Basic Electrical Requirements; Section 16111, Conduit; Section 16170, Grounding and Bonding; the applicable sections of Division 2, Sitework; Section 03200, Reinforcing Steel; and 03300, Cast-In-Place Concrete.

1.02 CODES AND STANDARDS

- A. Products specified herein shall be designed, manufactured, and/or listed to the following standards as applicable:
  - 1. AASHTO H20
  - 2. ANSI/SCTE 77-2010 – Specification for Underground Enclosure Integrity

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit Shop Drawings. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to, the following:

1. Product data sheets.
2. Outline and dimensional drawings including detailed sections of the manholes and/or handholes.
3. Materials specifications and structural calculations for the manholes sealed by a Professional Engineer in the State of North Carolina.

#### 1.05 IDENTIFICATION

- A. Each electric manhole and handhole cover shall be lettered with the word "Electric", the manhole or handhole identification number (e.g. EHH-1, etc.), manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

### PART 2 – PRODUCTS

#### 2.01 MANUFACTURERS

- A. The material covered by this Specification is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings.

#### 2.02 DUCT SYSTEM

- A. Underground duct system shall consist of parallel runs of Schedule 40 PVC conduit or PVC coated rigid galvanized steel conduit encased in concrete envelopes, unless otherwise specified herein or indicated on the Drawings.
- B. Nonmetallic conduit joints shall be made with standard Schedule 40 PVC couplings and PVC solvent cement of the same manufacturer as the conduit. All PVC conduit shall be supplied by the same manufacturer. All joints shall be staggered, installed in accordance with the manufacturer's recommendations, and made watertight.
- C. Base and intermediate conduit spacers shall be furnished to provide a minimum of two-inch (2") separation between conduits. Conduit spacers shall be provided in the proper size as required for the conduit that they secure. For example, a 4" conduit spacer shall not be used to secure a 2" conduit. Conduit spacers shall be as manufactured by Carlon Electrical Products Company, Aeroquip Corporation, Underground Devices, Incorporated, or equal.
- D. All 90 degree conduit elbows and/or combinations of adjacent conduit elbows that form a 90 degree bend shall be PVC coated rigid galvanized steel conduit.

#### 2.03 ELECTRIC HANDHOLES

- A. The electric handholes shall be a precast polymer concrete enclosure suitable for use as part of an underground electric raceway system. The enclosure shall meet or exceed the requirements of ANSI/SCTE 77-2010.

- B. The enclosure design and test load rating shall be Tier 15.
- C. The enclosure shall be the straight side design to allow easy adjustment of box to grade. The box shall be stackable for increased depth.
- D. Handhole opening size shall be as required to suit the application, 6" X 8", minimum.
- E. Extra heavy duty covers shall be furnished and installed with Tier 15 enclosures. Covers shall be provided with cover hooks.
- F. The electric handholes shall be Style "PG" or "PC" (as required) Quazite boxes as manufactured by Hubbell, Pencil Plastics equivalent, Highline Products equivalent, or equal.

### PART 3 – EXECUTION

#### 3.01 GENERAL

- A. The underground duct system, manholes, and handholes shall be installed as specified herein, indicated on the Drawings, and in accordance with manufacturers' instructions.

#### 3.02 DUCT SYSTEM

- A. All underground conduit shall be encased in concrete and shall be reinforced. Encasement and reinforcement shall be as indicated in the standard details. Concrete shall be furnished and installed in accordance with Section 03300. Reinforcing steel shall be furnished and installed in accordance with Section 03200. Concrete electrical duct banks shall contain red dye; the red dye shall be mixed into the concrete mix before being poured. Red dye applied to the top of concrete encasement after placement of concrete is not acceptable.
- B. Concrete pours shall be complete from handhole to handhole and from manhole to manhole where practicable. Partial pours in general shall not be permitted. Where a complete pour is impractical, written authorization shall be obtained from the Engineer for the partial pour.
- C. Conduit ductbank elevations at the manholes and handholes shall be based on minimum ductbank cover as indicated in the standard details, or deeper to avoid conflicts with other obstacles. Where deviation is necessary to clear unforeseen obstacles, the elevations may be changed after authorization by the Engineer.
- D. Slope all conduits continuously away from structures and buildings with a minimum slope of 3" per 100' unless otherwise indicated on the Drawings.
- E. The minimum clearance from the top of the concrete encasement and finished grade shall be as indicated in the standard details, except where otherwise accepted in writing by the Engineer or shown on the Drawings.
- F. Care shall be exercised during excavation for the duct banks to prevent digging too deep. Backfilling of low spots with earth fill will not be permitted unless thoroughly compacted and acceptable to the Engineer.

- G. If a specific ductbank arrangement is shown on the Drawings, the conduits in that ductbank shall be arranged as shown. Where no specific ductbank arrangement is shown on the Drawings, the Contractor shall arrange conduits within each ductbank based on field conditions. Spare conduits shown going from ductbanks into buildings or structures shall be stubbed up in the location(s) as indicated on the Drawings.
- H. A minimum of one (1) ground rod, furnished in accordance with Section 16170, shall be driven adjacent to each manhole, handhole, or other concrete box. A No. 4/0 AWG bare copper ground cable shall be connected between this rod and the copper ground strap using a silicon bronze connector. All ground rods shall be interconnected by means of the No. 4/0 AWG bare copper ground cable located within each duct bank. The ends of these cables shall also be connected to substation and/or building ground buses where the conduits terminate.
- I. Care shall be exercised and temporary plugs shall be installed during installation to prevent the entrance of concrete, mortar, or other foreign matter into the conduit system. Conduit spacers shall be utilized to support conduit during the pouring of concrete to prevent movement and misalignment of the conduits. Conduit spacers shall be installed in accordance with manufacturer's instructions unless otherwise noted. Horizontal spacing of conduit spacers along ductbank shall be as indicated on the Standard Details.
- J. Large radius elbows shall be used for all 90 degree conduit bends in the duct system. The following shall be the minimum elbow radii:

TRADE SIZE	1"	1 ½"	2"	2 ½"	3"	3 ½"	4"
MIN. RADIUS	12"	24"	24"	24"	36"	36"	48"

- K. Prior to pulling cables, the Contractor shall thoroughly clean the inside of each length of conduit by swabbing.
- L. After all cables have been installed, all spare and/or unused conduit openings shall be sealed or plugged as specified in Section 16111. A 250 lb. test pull rope shall be provided in the entire length of all spare and/or unused conduits.
- M. Where connections to existing underground conduits are indicated, excavate to the maximum depth necessary. After addressing the existing conductors, cut the conduits and remove loose concrete from the conduits before installing new concrete encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct line, to take the shear at the joint of the duct lines.
- N. Construct concrete-encased conduits connecting to underground structures to have a flared section adjacent to the manhole to provide shear strength. Construct underground structures to provide shear strength. Construct underground structures to provide for keying the concrete encasement of the duct line into the wall of the structure. Use vibrators when this portion of the encasement is poured to ensure a seal between the encasement and the wall of the structure.
- O. Six (6) inches above all duct banks, the Contractor shall furnish and install a two (2) inch wide red plastic electrical hazard tape. Tapes shall be metallic detectable type and shall have a continuous message in bold black letters: "ELECTRIC LINE BURIED BELOW." Tape shall be Detectable Identoline by Brady, or equal.

- P. The Contractor shall perform all earthwork including excavation, backfill, bedding, compaction, shoring and bracing, grading and restoration of surfaces and seeded areas disturbed during the execution of the work.

### 3.03 ELECTRIC HANDHOLES

- A. Electric handholes shall be installed to a sufficient depth to accommodate the required grading of ducts as well as maintaining a minimum distance of 9" from the bottom of the lowest duct centerline entrances to finished floor line and/or highest duct centerline entrance to roof. All handholes shall be built on, or placed over a 6" layer of well-tamped gravel.
- B. Duct envelopes and conduit with bell ends shall enter at approximately right angles to the walls, except as may otherwise be shown on the Drawings.
- C. All fully assembled handholes shall be completely watertight.
- D. All individual cables and/or bundles of conductors shall be identified and "dressed" along the wall of the enclosure. Cable racks as specified herein shall be provided if any handhole dimension exceeds 24 inches.

### 3.04 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
  - 1. Field tests
    - a. Field tests for all completed duct systems shall consist of pulling a swab through each conduit followed by a mandrel equal in size to 85% of the conduit inside diameter.
    - b. After testing, all conduits shall be capped after installation of a suitable pull rope. All field tests shall be witnessed by the Engineer.

- - END OF SECTION - -



SECTION 16123  
LOW VOLTAGE WIRE AND CABLE

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, all low voltage wire and cable indicated on the Drawings and as specified herein and/or required for proper operation. The work of connecting cables to equipment and devices shall be considered a part of this Section. All appurtenances required for the installation of cable and wire systems shall be furnished and installed by the Contractor.
- B. The scope of this Section does not include internal wiring factory installed by electrical equipment manufacturers.
- C. Reference Section 16000, Basic Electrical Requirements; Section 16111, Conduit; Section 16118, Underground Electrical; and Section 16130, Boxes.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the wire and cable manufacturer and submit the following:
  - 1. Shop Drawings
  - 2. Reports of Field Tests
  - 3. Wiring Identification Methods
- B. Each submittal shall be identified by the applicable specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
  - 1. Product data sheets.
  - 2. Cable pulling calculations (if required).

3. Wiring identification methods and materials.

1.04 IDENTIFICATION

- A. Each cable shall be identified as specified in Part 3, Execution, of this Specification.

1.05 CABLE PULLING CALCULATIONS

- A. The Contractor shall submit cable pulling calculations. These calculations, to be performed by a currently registered professional engineer in the State of North Carolina, shall define pulling tension and sidewall loading (sidewall bearing pressure values) for all installations of 600VAC, #1/0 conductors and larger greater than 200 feet in length. Calculations for straight horizontal installations of 600VAC, #1/0 conductors and larger greater than 200 feet are not required.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years. Wire and cable shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings. Only one (1) manufacturer for each wire and cable type shall be permitted.
- B. The wire and cable manufacturer shall be ISO 9000 registered.

2.02 POWER WIRE AND CABLE

- A. Power cable and wire shall consist of stranded, copper conductor with insulation type THHN, 90°C for dry locations and THWN, 75°C for wet locations.
- B. Conductors shall be stranded copper per ASTM-B8 and B-3, and Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be No. 12 AWG.
- C. Multi-conductor power cable assemblies shall be UL 1277 Listed, provided with a bonding conductor, and furnished with an overall PVC jacket.
- D. Power wire and cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, or equal.

2.03 CONTROL CABLE

- A. 600 volt control cable shall consist of stranded, copper conductor with insulation type THHN, 90°C for dry locations and THWN, 75°C for wet locations, and 600V.



- B. Conductors shall be stranded copper per ASTM B-8 and B-3, and Class B or C stranding contingent on the size unless otherwise specified. Minimum wire size shall be No. 14 AWG.
- C. Multi-conductor control cable assemblies shall be UL 1277 Listed, provided with a bonding conductor, and furnished with an overall PVC jacket.
- D. Control cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, or equal.

#### 2.04 LIGHTING AND RECEPTACLE WIRE

- A. The lighting and receptacle branch circuit wire shall consist of solid, copper conductors with insulation type THHN, 90°C for dry locations and THWN, 75°C for wet locations.
- B. Conductors shall be solid copper per ASTM- B-3. Minimum size wire shall be No. 12 AWG.
- C. Lighting and receptacle wire shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, or equal.

#### 2.05 INSTRUMENTATION CABLE

- A. The instrumentation cable for analog signals shall be single, shielded, twisted pairs or triads with 600 volt insulation and shall have a 75°C (minimum) insulation rating.
- B. Conductors shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM-B8, Class B stranding unless otherwise specified. Minimum size wire shall be No. 16 AWG.
- C. The instrumentation cable shall be Okoseal-N Type P-OS for single pair or triad applications and Okoseal-N Type SP-OS for multiple pair or triad applications as manufactured by the Okonite Company, Belden equivalent, Southwire Company equivalent, or equal.

#### 2.06 CONDUCTOR IDENTIFICATION

- A. Conductors shall be identified using a color coding method. Color coding for individual power, control, lighting, and receptacle conductors shall be as follows:

##### 1. 480/277V AC Power

Phase A - BROWN  
Phase B - ORANGE  
Phase C - YELLOW  
Neutral – GREY

##### 2. 120/208V or 120/240V AC Power

Phase A - BLACK  
Phase B - RED  
Phase C - BLUE  
Neutral - WHITE

3. DC Power

Positive Lead - RED  
Negative Lead - BLACK

4. DC Control

All wiring - BLUE

5. 120VAC Control

120 VAC control wire shall be RED except for a wire entering a motor control center compartment or control panel which is an interlock. This interlock conductor shall be color coded YELLOW.

6. 24VAC Control

All wiring - ORANGE

7. Equipment Grounding Conductor

All wiring - GREEN

- B. Individual conductors No. 2 AWG and smaller shall have factory color coded insulation. It is acceptable for individual conductors larger than No.2 AWG to be provided with factory color coded insulation as well, but it is not required. Individual conductors larger than No.2 AWG that are not provided with factory color coded insulation shall be identified by the use of colored tape in accordance with the requirements listed in Part 3 herein. Insulation colors and tape colors shall be in accordance with the color coding requirements listed above.
- C. Conductors that are a part of multi-conductor control cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor within the cable assembly shall also be identified with a heat shrink tag with color coded background in accordance with the requirements listed in Part 3 herein. Background color shall be in accordance with the color coding requirements listed above.
- D. Conductors that are a part of multi-conductor power cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor No.2 AWG and smaller within the cable assembly shall also be identified with a heat shrink tag with color coded background. Each conductor larger than No.2 AWG within the cable assembly shall also be identified by the use of colored tape. Heat shrink tags and colored tape shall be in accordance with the requirements listed in Part 3 herein. Tape color and heat shrink tag background color shall be in accordance with the color coding requirements listed above.

## 2.07 CABLE PULLING LUBRICANTS

- A. Cable pulling lubricants shall be non-hardening type and approved for use on the type of cable installed. Lubricant shall be Yellow #77 Plus by Ideal, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or equal.

## PART 3 – EXECUTION

### 3.01 POWER, CONTROL, AND LIGHTING/RECEPTACLE WIRE AND CABLE INSTALLATION

- A. The wire and cable shall be installed as specified herein and indicated on the Drawings.
- B. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.
- C. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical, or equal.
- D. Splices shall not be allowed in the underground manhole and handhole systems. If splices are required, the Contractor shall obtain approval in writing from the Engineer prior to splicing. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. No splicing of instrumentation cable is allowed. The use of screw-on wire connectors (wire nuts) shall only be permitted for lighting and receptacle circuits.
- E. Wire and Cable Sizes
  - 1. The sizes of wire and cable shall be as indicated on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop measured from source to load does not exceed 2-1/2%.
- F. Additional Conductor Identification
  - 1. In addition to the color coding identification requirements specified in Part 2 herein, individual conductors shall be provided with heat shrinkable identification tags. Identification tags for individual conductors shall have a white background where the conductor insulation is colored. Identification tags for individual conductors shall have a colored background where the conductor insulation is black. Background color shall match that of the taping provided on the individual black conductors.
  - 2. Multi-conductor cables shall be provided with heat shrinkable identification tags in accordance with Part 2 herein.
  - 3. All wiring shall be identified at each point of termination. This includes but is not limited to identification at the source, load, and in any intermediate junction boxes where a termination is made. The Contractor shall meet with the Owner and Engineer to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.

4. Wire identification shall be by means of a heat shrinkable sleeve with appropriately colored background and black text. Wire sizes #14 AWG through #10 AWG shall have a minimum text size of 7 points. Wire sizes #8 AWG and larger shall have a minimum text size of 10 points. Sleeves shall be of appropriate length to fit the required text. The use of handwritten text for wire identification shall not be permitted.
5. Sleeves shall be suitable for the size of wire on which they are installed. Sleeves shall not be heat-shrunk onto control cables. Tags shall remain loose on cable to promote easier identification. For all other applications, sleeves shall be tightly affixed to the wire and shall not move. Sleeves shall be heat shrunk onto wiring with a heat gun approved for the application. Sleeves shall not be heated by any means which employs the use of an open flame. The Contractor shall take special care to ensure that the wiring insulation is not damaged during the heating process.
6. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.
7. Sleeves shall be polyolefin as manufactured by Brady, Seton, Panduit, or equal.
8. Wire identification in manholes, handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous (no terminations are made) shall be accomplished by means of a tag installed around the bundled group of individual conductors or around the outer conductor jacket of a multi-conductor cable. Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all of the individual conductors in a single conduit or duct. The tag shall have text that identifies the bundle in accordance with the 'FROM' and 'TO' column for that particular conduit number in the conduit and wire schedule. Minimum text size shall be 10 point. The tag shall be affixed to the wire bundle by the use of nylon wire ties, and shall be made of polyethylene as manufactured by Brady, Seton, Panduit, or equal.
9. Where colored tape is used to identify cables, it shall be wrapped around the cable with a 25% overlap and shall cover at least 2 inches of the cable.

#### G. Wiring Supplies

1. Only electrical wiring supplies manufactured under high standards of production and meeting the approval of the Engineer shall be used.
2. Rubber insulating tape shall be in accordance with ASTM Des. D119. Friction tape shall be in accordance with ASTM Des. D69.

#### H. Training of Cable

1. The Contractor shall furnish all labor and material required to train cables around cable vaults within buildings and in manholes and handholes in the outdoor underground duct system. Sufficient length of cable shall be provided in each handhole, manhole, and vault so that the cable can be trained and racked in an approved manner. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing. Reference Section 16118.

2. Instrumentation cable shall be racked separate from other AC and DC wiring to maintain the required separation as follows:
  - a. 18 inches for 480/277VAC wiring
  - b. 12 inches for 208/120VAC wiring
  - c. 6 inches for 24VDC wiring

I. Conductor Terminations

1. Where wires are terminated at equipment which requires lugs, connections shall be made by solderless mechanical lug, crimp type ferrule, or irreversible compression type lugs. Reference individual equipment specification sections as applicable for additional termination requirements.
2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make terminations impractical due to the size of the field wiring, the Contractor shall terminate field wiring in an adjacent junction per the requirements of Section 16130, Boxes, complete with terminal strips. Contractor shall install the smaller wiring from the device to the junction box in a conduit, using the terminal strip as the means for joining the two different wire sizes. Splicing of wires in lieu of using terminal strips is not acceptable.
3. All spare conductors shall be terminated on terminal blocks mounted within equipment or junction boxes. Unless otherwise noted, coiling up of spare conductors within enclosure is not acceptable.

J. Pulling Temperature

1. Cable shall not be flexed or pulled when the temperature of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature of 40°F or less within a three (3) day period prior to pulling, the cable reels shall be stored three (3) days prior to pulling in a protected storage area with an ambient temperature of 55°F or more. Cable pulling shall be completed during the work day for which the cable is removed from the protected storage. Any remaining cable reels shall be returned to storage at the completion of the workday.

3.02 INSTRUMENTATION CABLE INSTALLATION

- A. The Contractor shall install all cable or conductors used for instrumentation wiring (4 20 mA DC, etc.) in conduit as specified in Section 16111 - Conduit. Only instrumentation cable as specified herein shall exclusively occupy these conduits. No other wiring for AC or discrete DC circuits shall be installed in these conduits.
- B. All shielding shall be continuous and shall be **grounded at one point only**.
- C. Where instrumentation cables are installed in panels, manholes, handholes, and other locations, the Contractor shall arrange wiring to provide maximum clearance between

these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.

- D. Special instrument cable shall be as specified or recommended by the manufacturer of the equipment or instruments requiring such wiring. Installation, storage, and terminations, shall be per manufacturer's recommendations.

### 3.03 TESTING

- A. All testing shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

- 1. Shop Test

- a. Cable and wiring shall be tested in accordance with the applicable ICEA Standards. Wire and cable shall be physically and electrically tested in accordance with the manufacturer's standards.

- 2. Field Tests

- a. After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be "test light" or "buzzer" style.
  - b. After installation, some wires and cables shall be tested for insulation levels. Insulation resistance between conductors of the same circuit and between conductor and ground shall be tested. Testing for insulation levels shall be as follows:
    - 1) (For #8 AWG and larger 600V power and control cable, apply 1,000 VDC from a Megaohmmeter for one (1) minute for all 600V wires and cables installed in lighting, control, power, indication, alarm and motor feeder circuits. Resistance shall be no less than 100 Megaohms. Insulation testing is not required for power and control cables smaller than #8 AWG.
    - 2) (600V instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter, or approved equal. The resistance value shall be 200 Megaohms or greater.

- B. Wires and cables shall be tested before being connected to motors, devices or terminal blocks.
- C. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner.
- D. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment. Test reports shall be submitted to the Engineer.

- - END OF SECTION - -

(EXHIBIT A) TEST DATA - MEGOHMS TEST NO. _____							
Date:			Company:				
Time:			Location:				
Circuit:	Circuit Length:	Aerial:	Duct:	Buried:	No. of Conductors	Size:	AMG MCM Shld:
Insulation Material:			Insulation Thickness:		Voltage Rating:		Age:
Type: _____Pothead _____Terminal					Location:       Indoors_____		
					Outdoors_____		
Number and Type of Joints:							
Recent Operating History:							
Manufacturer:							
State if Potheads or Terminals were grounded during test:							
List associated equipment included in test:							
Miscellaneous Information:							

(EXHIBIT A) TEST DATA - MEGOHMS TEST NO. ____							
Part Tested: Test Made: _____ Hours/Days: _____ After Shutdown: _____							
Grounding Time: Dry Bulb Temperature: _____ Wet Bulb Temperature: _____							
Test Voltage: _____				Equipment Temperature: _____ How Obtained: _____ Relative Humidity: _____ Absolute Humidity: _____ Dew Point: _____			
Megohmmeter:    Serial Number: _____    Range: _____ Voltage: _____    Calibration Date: _____							
Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground
<input type="checkbox"/> Minute				5 Minutes			
<input type="checkbox"/> Minute				6 Minutes			
3/4 Minute				7 Minutes			
1 Minute				8 Minutes			
2 Minutes				9 Minutes			
3 Minutes				10 Minutes			
4 Minutes				10/1 Minutes			
				Ratio			
Remarks:							



## SECTION 16130

### BOXES

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. The scope of work under this Section includes furnishing and installing all pull boxes, junction boxes, and outlet boxes.
- B. Requirements for other boxes and enclosures are not included in this Section. Reference each specific Division 16 equipment Section for requirements related to that equipment's respective enclosure.
- C. Reference Section 16000, Basic Electrical Requirements, and Section 16111, Conduit.

##### 1.02 CODES AND STANDARDS

- A. Boxes shall be designed, manufactured, and/or listed to the following standards as applicable:
  - 1. UL 514A - Metallic Outlet Boxes
  - 2. UL 514C - Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers
  - 3. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations
  - 4. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations
  - 5. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.
  - 6. NEMA 250 – Enclosures for Electrical Equipment

##### 1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer(s) and submit the following:
- B. Shop Drawings
- C. Each submittal shall be identified by the applicable specification section.

##### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
  - 1. Product data sheets for boxes, terminal strips, and all accessories

#### 1.05 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.
- B. As-built drawings showing dimensions, internal box layout, terminal strip information, and terminal strip identification information shall be provided for all junction boxes. As-built drawings are not required for pull boxes or outlet boxes.

#### 1.06 IDENTIFICATION

- A. Each pull and junction box shall be identified with the box name as indicated on the Contract Drawings or as directed by the Engineer. A nameplate shall be securely affixed in a conspicuous place on each box. Nameplates shall be as specified in Section 16195, Electrical – Identification.

### PART 2 – PRODUCTS

#### 2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

#### 2.02 PULL AND JUNCTION BOXES

##### A. General

- 1. All pull and junction boxes shall be UL listed and labeled.
- 2. Pull and junction boxes shall not be provided with eccentric or concentric knockouts.
- 3. Pull and junction boxes mounted embedded in concrete shall be UL listed for embedment.
- 4. Where metallic boxes are used they shall be of all welded construction. Tack welded boxes are not acceptable.

##### B. Pull Boxes

- 1. All pull boxes shall be provided with a matching gasketed cover. For covers with dimensions of 24 inches by 24 inches or less, the cover shall be held in place by machine screws. Other screw types are not acceptable. For covers with dimensions greater than 24 inches by 24 inches, the cover shall be hinged and held in place by

screw-operated clamp mechanisms. Hinge pins shall be removable. Clamp mechanism material of construction shall match that of the associated box.

2. Pull boxes shall not have any wire terminations inside, other than those for grounding/bonding. A ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the pull box (minimum of two) shall be provided as spare terminations. Boxes requiring any other wire terminations shall be furnished and installed in accordance with the requirements for junction boxes herein.
3. Pull boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC.
4. Barriers shall be provided in pull boxes to isolate conductors of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
  - a. Power wiring
  - b. AC control wiring
  - c. DC control wiring
  - d. Instrumentation wiring

#### C. Junction Boxes

1. Junction boxes used for lighting and receptacle circuits only shall be provided with a matching gasketed cover held in place by machine screws. Other screw types are not acceptable.
2. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with a hinged, gasketed cover. Hinge pins shall be removable. Cover shall be held in place by screw-operated clamp mechanisms. Clamp mechanism material of construction shall match that of the associated box.
3. Barriers shall be provided in junction boxes to isolate conductors and terminal blocks of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
  - a. Power wiring
  - b. AC control wiring
  - c. DC control wiring
  - d. Instrumentation wiring
4. Junction boxes used for lighting and receptacle circuits only shall be allowed to have screw-on (wire nut) type connectors for wire terminations/junctions.

5. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with terminal strips, consisting the necessary number of screw type terminals. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected, with a 10A minimum capacity. Terminal strips shall be rated for the voltage of the circuits connected. A separate ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the junction box (minimum of two) shall be provided as spare terminations. When barriers are provided within the box, separate terminal strips shall be provided in each barrier area. Terminals shall be lettered and/or numbered to conform to the wiring labeling scheme in place on the project.
6. Junction boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC. Terminal blocks (including spare terminals) shall be considered when sizing the junction box.

**D. Enclosure Types and Materials**

1. In non-hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

<b>AREA DESIGNATION</b>	<b>ENCLOSURE TYPE AND MATERIAL</b>
Indoor Wet Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Process Area	NEMA 12, Painted Steel
Indoor Dry Non-process Area	NEMA 1, Painted Steel
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass or PVC
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 304 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

2. In hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

<b>AREA CLASSIFICATION</b>	<b>ENCLOSURE TYPE AND MATERIAL</b>
Class 1, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class 1, Division 2, Group D	NEMA 4X, Type 304 Stainless Steel
Class 2, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class 2, Division 2, Group F	NEMA 4X, Type 304 Stainless Steel

3. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs.

## 2.03 OUTLET BOXES

### A. General

1. Outlet boxes shall be provided with a trim appropriate for the wiring device installed inside. Reference Section 16141, Wiring Devices, for outlet box trim requirements. An appropriate outlet box trim is required to achieve the NEMA rating of the outlet boxes as specified herein.

### B. Surface Mount Outlet Boxes

1. Outlet boxes shall be the deep type, no less than 2.5 inches deep.
2. Outlet boxes shall be provided in single or multi-gang configuration as required, sized in accordance with the requirements of the NEC.
3. In non-hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Cast Aluminum
Indoor Dry Process Area	NEMA 1, Cast Aluminum
Indoor Dry Non-process Area	NEMA 1, Cast Aluminum
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, PVC
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Cast Aluminum
All Outdoor Areas	NEMA 4X, Cast Aluminum

4. In hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	ENCLOSURE TYPE AND MATERIAL
Class 1, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class 1, Division 2, Group D	NEMA 4X, Cast Aluminum
Class 2, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class 2, Division 2, Group F	NEMA 4X, Cast Aluminum

5. Outlet boxes shall be provided with integral threaded conduit hubs mounted external to the box. Boxes with threaded conduit hubs mounted internal to the box or as a part of the box wall are not acceptable.

### C. Flush Mount Outlet Boxes

1. Outlet boxes shall be no less than 2-1/8 inches deep, and 4-11/16 inches square. Boxes shall be UL listed and labeled. Pre-punched single diameter conduit knockouts are acceptable, however, concentric and eccentric knockouts are not acceptable.

2. Outlet boxes mounted flush in CMU walls shall be made of galvanized, tack welded steel, and suitable for installation in masonry walls. Sectional type boxes are not acceptable for this application.
3. Outlet boxes mounted flush in gypsum walls shall be made of galvanized pressed steel. Tack welded boxes are not acceptable for this application. Sectional type boxes are not acceptable for this application.
4. Outlet boxes mounted cast into concrete shall be concrete tight, and shall be made of galvanized steel or PVC.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

#### A. Pull and Junction Boxes

1. Pull boxes and junction boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.
2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.
3. Box penetrations for conduits shall be made with a punch tool, and penetrations shall be of the size required for the conduit entry and/or hub. Oversized penetrations in boxes are not acceptable.
4. Watertight conduit hubs shall be provided for boxes where a NEMA 4X enclosure rating is specified. Reference Section 16111, Conduit, for conduit hub requirements.
5. Pull and junction boxes may be installed flush mounted in gypsum, concrete or CMU walls where appropriate provided that covers are easily removed or opened.
6. Pull and junction boxes shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

#### B. Outlet Boxes

1. Outlet boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.
2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.
3. Flush mounted outlet boxes shall be arranged and located so that tile and grout lines fit closely around the boxes, and so placed that the cover or device plate shall fit flush to the finished wall surface.

4. Outlet boxes shall be flush mounted in finished areas and other areas where practical. Flush mounted outlet boxes shall not be installed in hazardous areas and type 1 or 2 chemical storage/transfer areas.
5. For the below-named items, mounting heights from finished floor, or finished grade to top is applicable, depending on the type of wiring device to be installed in the outlet box. Mounting heights for outlet boxes shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):
  - a. Light switches and wall mounted occupancy sensors, 48 inches
  - b. Receptacles in indoor dry process/non-process areas, 16 inches
  - c. Receptacles in indoor wet process areas and all indoor chemical storage/transfer areas, 48 inches
  - d. Receptacles in outdoor locations, 24 inches
6. Outlet boxes shall be provided in the material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

- - END OF SECTION - -





## SECTION 16141

### WIRING DEVICES

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install all switches, occupancy sensors, and receptacles of the type and at the locations as shown on the Drawings.
- B. All switches and receptacles shall be furnished and installed in outlet boxes. Reference Section 16130, Boxes, for outlet box requirements.
- C. Reference Section 16000, Basic Electrical Requirements, and Section 16123, Low Voltage Wire and Cable.

##### 1.02 CODES AND STANDARDS

- A. Wiring devices shall be designed, manufactured, and/or listed to the following standards as applicable:
  - 1. UL 20 – General Use Snap Switches
  - 2. UL 498 – Standard for Attachment Plugs and Receptacles
  - 3. UL 943 – Ground Fault Circuit Interrupters
  - 4. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

##### 1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

##### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include, but not be limited to:

1. Product data sheets.

#### 1.05 SPARE PARTS

- A. The Contractor shall furnish 10% (minimum of 1) spare of each receptacle, switch, and plug furnished and installed for this project.
- B. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

#### 1.06 IDENTIFICATION

- A. Each switch and receptacle shall be identified with the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

### PART 2 – PRODUCTS

#### 2.01 MANUFACTURERS

- A. The equipment covered by these Specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. The Contractor shall use the products of a single manufacturer for each type of wiring device.
- C. The Contractor shall use the products of a single manufacturer for all device plates. Plate variations are allowed for the following devices:
  1. Where the selected plate manufacturer does not manufacture a suitable finish plate.
  2. For heavy duty receptacles rated at more than 30A.
  3. Where non standard plates are required, specified, or shown.
- D. The Contractor shall furnish and install all wiring devices and device plates.
- E. In non-hazardous areas, provide specification grade devices manufactured by Appleton, Crouse-Hinds, Leviton, Hubbell, Pass & Seymour, or Engineer approved equal.
- F. In hazardous areas, provide devices manufactured by Appleton, Cooper Crouse-Hinds, Hubbell-Killark, or Engineer approved equal.

## 2.02 WIRING DEVICES

- A. Wall switches for non-hazardous areas shall be rated for the current required to suit the application, but not less than 20A. Double pole, three-way, and four-way switches shall be provided where indicated on the Drawings, and as required. Switches shall be rated for 120-277VAC, and shall be UL 20 Listed.
- B. Convenience receptacles for non-hazardous areas shall be rated for 20A at 125VAC. Convenience receptacles shall be UL 498 Listed. Tamper resistant receptacles are not acceptable.
- C. Special purpose receptacles (welders, lab equipment, etc.) shall be provided with the proper NEMA configuration and ampacity as indicated on the Drawings. The coordinating plug for each special purpose receptacle shall be provided with the equipment which it is serving.
- D. Ground fault circuit interrupter receptacles shall be rated for 20A at 125VAC. Ground fault circuit interrupter receptacles shall be UL 943 Listed. Tamper resistant receptacles are not acceptable.
- E. Wall switches for hazardous areas shall be the factory sealed type, UL 1203 Listed for use in the hazardous area. Wall switches shall be rated for 120-277VAC, and shall be rated for the current required to suit the application, but not less than 20A
- F. Receptacles for hazardous areas shall be rated 20A at 120-240VAC. Receptacles shall be UL 1203 listed for use in the hazardous area, utilizing delayed-action construction.
- G. All wiring devices shall be approved for use with stranded conductors, if stranded conductors are to be used with the device. Reference Section 16123, Low Voltage Wire and Cable for conductor requirements

## 2.03 DEVICE PLATES

- A. Device plates for indoor flush mounted receptacles and switches shall be made of Type 304 stainless steel, not less than 0.032 of an inch thick, with beveled edges and milled on the rear so as to lie flat against the wall. Devices plates shall be provided with a gasket.
- B. Device plates for outdoor installations, indoor wet process areas, and chemical storage/transfer areas shall be Appleton Type FSK, Crouse Hinds #DS185, or equal for wall switches. Device plates for receptacles shall be "in-use" style. "In-use" weatherproof covers shall be rugged, minimum 3 ¼" depth, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," Intermatic International, Inc., or equal.
- C. Device plates for indoor dry process and non-process areas with surface mounted boxes shall be Crouse-Hinds DS32, or equal for switches, and Crouse-Hinds DS23 or equal for receptacles.

## 2.04 PLUGS

- A. The Contractor shall furnish suitable plugs with equipment furnished under the respective specification Section. Plugs shall be black rubber or plastic. For waterproof receptacles, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided with clamping nuts and stuffing gland cable outlets.

## 2.05 PROCESS INSTRUMENTS

- A. The Contractor shall furnish and install a local disconnect switch at each process instrument (e.g., level transmitter, flow transmitter, analytical instrument etc.,) to disconnect the 120VAC power supply to the instrument. The device shall be a NSSC series manual motor starting switch without overload protection as manufactured by Crouse-Hinds, Appleton equivalent, or equal. For hazardous locations, the device shall be UL 1203 Listed.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

- A. Where more than one (1) switch occurs at one (1) location, gang plates shall be used.
- B. All device plates shall be set true and plumb, and shall fit tightly against the finished wall surfaces and outlet boxes.
- C. Wiring device box (outlet box) mounting heights shall be as specified in Section 16130, Boxes.
- D. When indicated height would place any of the equipment at an unsuitable location such as at a molding or break in wall finish, the Contractor shall bring it to the attention of the Engineer for a decision.
- E. Receptacles installed in toilet, locker, and bathrooms, and within 6 feet of a sink, shall be of ground fault interrupter type. Ground fault circuit interrupter receptacles shall also be furnished and installed in additional locations where indicated on the Drawings, and as required by the NEC.
- F. All receptacles shall have a self-adhesive label installed on the top at the respective device plate that indicates which panel and which circuit number the receptacle is supplied from. Labels shall have a white background and black lettering in 14 point font.

### 3.02 CIRCUITING

- A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight (8) convenience receptacles are permitted per 20A, 120V circuit, unless otherwise indicated on the Drawings.

- - END OF SECTION - -

SECTION 16170  
GROUNDING AND BONDING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered a minimum requirement for compliance with this Specification.
- B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100-92, Powering and Grounding of Sensitive Electronic Equipment. Conflicts shall be promptly brought to the attention of the Engineer.
- C. In addition to the NEC requirements, building structural steel columns shall be permanently and effectively grounded:
- D. Reference Section 16000, Basic Electrical Requirements

1.02 CODES AND STANDARDS

- A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:
  - 1. UL 467 – Grounding and Bonding Equipment
  - 2. IEEE 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings
  - 2. Reports of certified field tests.
- B. Each submittal shall be identified by the applicable specification section.

#### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
  - 1. Product data sheets.
  - 2. Drawings and written description of how the Contractor intends to furnish and install the grounding system.

### PART 2 – PRODUCTS

#### 2.01 MANUFACTURERS

- A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

#### 2.02 GROUND RODS AND GRID

- A. Ground rods shall be rolled to a commercially round shape from a welded copper clad steel manufactured by the molten welding process or by the electro formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.010 inch at any point on the rod. Ground rods shall be UL 467 listed. The ground rods shall be manufactured by Erico Products, Blackburn, or equal.
- B. Except where specifically indicated otherwise, all exposed non current carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways and neutral conductors of wiring systems shall be grounded.
- C. The ground connection shall be made at the main service equipment and shall be extended to the ground grid surrounding the structure. The ground grid shall also be connected to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection.
- D. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

## 2.03 FITTINGS

- A. Grounding connections to equipment shall be bolted. Cable end connections shall be made by hydraulic crimp or exothermically welded. Split bolt type connectors are not acceptable. Fittings shall be UL 467 listed.

## 2.04 EQUIPMENT GROUNDING CONDUCTORS

- A. An insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Insulation shall be of the same type as the underground conductors in the raceway and shall be green in color. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

## 2.05 EQUIPMENT GROUNDS

- A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panelboards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.

## 2.06 EXOTHERMIC WELDS

- A. All exothermic welding shall be completed per welding kit manufacturer's instructions. Exothermic welds shall be CadWeld by Erico or ThermoWeld.

# PART 3 – EXECUTION

## 3.01 INSTALLATION

- A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.
- B. Ground Grid
  - 1. A main ground grid shall be provided for each structure and interconnecting structure grids consisting of driven ground rods as shown on the Drawings. The ground rods shall be interconnected by the use of copper cable exothermically welded to the rods. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtails" shall be connected to the ground grid and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section and as required to provide a complete grounding system. The copper pigtails shall be exothermically welded to the ground grid, and connected to building reinforcement steel by hydraulic crimp.
  - 2. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.

3. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.
4. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.
5. Buried exothermic welds and ground ring shall not be backfilled until inspected by Engineer.

C. Raceways

1. Conduit which enters equipment such as switchgear, motor control centers, transformers, panelboards, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
  1. Witnessed Shop Tests
    - a. None required.
  2. Field Tests
    - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.
    - b. Fall of potential tests shall be performed on the ground grid per IEEE81 recommendations by a third party, independent testing firm. A fall of potential plot shall be submitted at the conclusion of testing for Engineer review. Documentation indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made shall be submitted. Testing shall show that the ground grid has 5 ohms resistance or less. Due to soil conditions and/or unforeseen field conditions, ground resistances greater than 5 ohms may be acceptable if specifically approved in writing by the Engineer. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground grid under test isolated from other grounds.
    - c. Continuity tests for the grounding electrode conductor shall also be performed. Test will be accepted when a resistance of less than 1 ohm is shown for this conductor.

- - END OF SECTION - -



SECTION 16190  
SUPPORTING DEVICES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install structural supports for mounting and installing all conduit, electrical equipment, lighting, alarm systems, instrumentation, and communications equipment furnished under this Contract.
- B. Equipment shall be installed strictly in accordance with recommendations of the manufacturer and best practices of the trade resulting in a complete, operable, and safe installation. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation.
- C. Reference Section 16000, Basic Electrical Requirements.

1.02 CODES AND STANDARDS

- A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:
  - 1. ASTM A123 – Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
  - 2. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
  - 3. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 4. ASTM A276 – Standard Specification for Steel Bars and Shapes
  - 5. ASTM B783 – Standard Specification for Materials for Ferrous Powder Metallurgy Structural Parts

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop drawings
  - 2. Structural support calculations (if required)
- B. Each submittal shall be identified by the applicable Specification section.

#### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
  - 1. Product data sheets.
  - 2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

### PART 2 – PRODUCTS

#### 2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

#### 2.02 MATERIALS

- A. Support channel shall be 1-5/8" by 1-5/8" minimum, with 12 gage material thickness.
- B. Support channel, support channel fittings, and threaded rod shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	MATERIAL OF CONSTRUCTION
Indoor Wet Process Area	Type 304 Stainless Steel
Indoor Dry Process Area	Hot Dipped Galvanized Steel
Indoor Dry Non-process Area	Hot Dipped Galvanized Steel
Indoor Type 1 Chemical Storage/Transfer Area	Fiberglass
Indoor Type 2 Chemical Storage/Transfer Area	Type 304 Stainless Steel
All Outdoor Areas	Type 304 Stainless Steel
All Hazardous Areas	Type 304 Stainless Steel

- C. Fastening hardware (bolts, nuts, washers, and screws) shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

<b>AREA DESIGNATION</b>	<b>MATERIAL OF CONSTRUCTION</b>
Indoor Wet Process Area	Type 304 Stainless Steel
Indoor Dry Process Area	Type 304 Stainless Steel
Indoor Dry Non-process Area	Type 304 Stainless Steel
Indoor Type 1 Chemical Storage/Transfer Area	Fiberglass
Indoor Type 2 Chemical Storage/Transfer Area	Type 304 Stainless Steel
All Outdoor Areas	Type 304 Stainless Steel
All Hazardous Areas	Type 304 Stainless Steel

### PART 3 – EXECUTION

#### 3.01 INSTALLATION

##### A. Concrete or Masonry Inserts

1. The Contractor shall be responsible for the furnishing and installation of all anchor bolts, masonry inserts, and similar devices required for installation of equipment furnished under this Contract.
2. If a time delay for the arrival of any special inserts or equipment drawings, etc. occurs, the Contractor may, if permitted by the Engineer, make arrangements for providing approved recesses and openings in the concrete or masonry and, upon subsequent installation, the Contractor shall be responsible for filling in such recesses and openings. Any additional costs that may be incurred by this procedure shall be borne by the Contractor.
3. The Contractor shall furnish leveling channels for all switchgear, switchboards, motor control centers, and similar floor mounted equipment. The leveling channels shall be provided for embedment in the equipment housekeeping pads. Coordination of the installation of these channels with the concrete pad is essential and required. Pad height shall be as required to maintain concrete coverage of the reinforcement bars while not causing associated equipment to exceed the maximum mounting height requirements of the NEC.

##### B. Support Fastening and Locations

1. All equipment fastenings to columns, steel beams, and trusses shall be by beam clamps or welded. No holes shall be drilled in the steel.
2. All holes made in reflected ceilings for support rods, conduits, and other equipment shall be made adjacent to ceiling grid bars where possible, to facilitate removal of ceiling panels.
3. Support channel shall be provided wherever required for the support of starters, switches, panels, and miscellaneous equipment.

4. All equipment, devices, and raceways that are installed on the dry side of a water bearing wall shall not be installed directly onto the wall. Support channel shall be used to allow ventilation air to pass behind the equipment, devices, or raceway.
5. All supports shall be rigidly bolted together and braced to make a substantial supporting framework. Where possible, control equipment shall be grouped together and mounted on a single framework.
6. Aluminum support members shall not be installed in direct contact with concrete. Stainless steel or non-metallic "spacers" shall be used to prevent contact of aluminum with concrete.
7. Actual designs for supporting framework should take the nature of a picture frame of support channels and bracket with a plate for mounting the components. The Contractor is responsible for the design of supporting structure; he shall submit design details to the Engineer for acceptance before proceeding with the fabrication.
8. Wherever dissimilar metals come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.
9. For all installations where fiberglass supporting materials are required, the Contractor shall submit structural calculations and the details of the proposed system of support. Structural calculations shall be signed and sealed by a registered professional engineer in the State of North Carolina.
10. For the following installations where conduits are provided with a support system suspended from the above or attached to a vertical structure, the Contractor shall submit structural calculations and details of the proposed system of support. Structural calculations shall be signed and sealed by a registered professional engineer in the State of North Carolina.
  - a. A quantity of twelve (12) or more conduits trade size 1" and smaller are proposed for a conduit support rack.
  - b. A quantity of eight (8) or more conduits trade sizes 1 1/2" to 2 1/2" are proposed for a conduit support rack.
  - c. A quantity of four (4) or more conduits trade sizes 3" and larger are proposed for a conduit support rack.
11. Single conduits installed exposed along walls and ceilings shall be secured to the wall or ceiling with a one-hole conduit clamp and clamp-back. Where multiple conduits are installed exposed together, support channel and conduit clamps shall be used.

- - END OF SECTION - -

SECTION 16195  
ELECTRICAL - IDENTIFICATION

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. All switchgear, switchboards, motor control centers, variable frequency drives, lighting and distribution panelboards, combination starters, control panels, pull and junction boxes, enclosures, disconnect switches, control stations, and similar equipment shall be identified in the manner described, or in an equally approved manner.
- B. The types of electrical identification specified in this section include, but are not limited to, the following:
  - 1. Operational instructions and warnings.
  - 2. Danger signs.
  - 3. Equipment/system identification signs.
  - 4. Nameplates.

1.02 SIGNS

- A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms.

1.03 LETTERING AND GRAPHICS

- A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

## 1.05 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
  - 1. Product data sheets.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

### 2.02 NAMEPLATES

- A. Nameplates shall be engraved, high pressure plastic laminate, white with black lettering.
- B. Nameplates shall be attached to NEMA 4X enclosures utilizing UL-recognized mounting kits designed to maintain the overall UL Type rating of the enclosure. Mounting kit fasteners shall be stainless steel Type AHK10324X as manufactured by Hoffman, or equal.

### 2.03 HIGH VOLTAGE SIGNS

- A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate identification.

### 2.04 CONDUIT IDENTIFICATION

- A. Conduit identification shall be as specified in Section 16111, Conduit.

### 2.05 WIRE AND CABLE IDENTIFICATION

- A. Field installed wire and cable identification shall be as specified in Section 16123, Low Voltage Wire and Cable.
- B. A plastic laminate nameplate shall be provided at each panelboard, motor control center, switchgear assembly, and switchboard assembly. This nameplate shall be used to clearly convey the conductor identification means used at that piece of equipment (i.e. Phase A=Brown, Phase B=Orange, C = Yellow).

- C. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective section.

## 2.06 BOX IDENTIFICATION

- A. Pull, junction and device box identification shall be as specified in Section 16130 – Boxes.

## PART 3 – EXECUTION

### 3.01 NAMEPLATES

- A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

### 3.02 OPERATIONAL IDENTIFICATION AND WARNINGS

- A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

### 3.03 POWER SOURCE IDENTIFICATION

- A. After installation of all field equipment (i.e. valves, motors, fans, unit heaters, instruments, etc) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC number, panelboard, etc), circuit number, conduit number from schedule and voltage/phase.
- B. Contractor to coordinate with the Engineer and the Owner regarding exact nameplate placement during construction.
- C. Nameplates shall be as specified herein.

- - END OF SECTION - -





SECTION 16476  
ENCLOSED CIRCUIT BREAKERS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install enclosed circuit breakers of voltage and current ratings as specified herein and indicated on the Drawings.
- B. This specification is intended to apply to circuit breakers separately-mounted from other equipment in an individual enclosure. This Section does not apply to circuit breakers as part of an equipment assembly such as motor control centers, panelboards, switchboards, etc.
- C. Reference Section 16000, Basic Electrical Requirements.

1.02 CODES AND STANDARDS

- A. Enclosed circuit breakers shall comply with the following codes and standards:
  - 1. UL 489 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures
  - 2. NEMA 250 – Enclosures for Electrical Equipment
  - 3. National Electrical Code

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings.
  - 2. Spare Parts List.
  - 3. Operation and Maintenance Manuals.
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
  - 1. Product data sheets.
  - 2. Complete assembly, layout, and installation drawings with clearly marked dimensions for each enclosed circuit breaker.

#### 1.05 SPARE PARTS

- A. For each enclosed circuit breaker, the Contractor shall furnish to the Owner all spare parts as recommended by the equipment manufacturer.

#### 1.06 IDENTIFICATION

- A. Each enclosed circuit breaker shall be identified with the identification name and/or number indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on the front of each enclosed circuit breaker. Nameplates shall be as specified in Section 16195, Electrical - Identification.

### PART 2 – PRODUCTS

#### 2.01 MANUFACTURERS

- A. The Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. Enclosed circuit breakers shall be manufactured by Eaton, the General Electric Company, the Square D Company, or Siemens Energy and Automation, Inc.

#### 2.02 ENCLOSED CIRCUIT BREAKERS

- A. Circuit breakers shall be molded case type with trip and frame ratings as indicated on the Drawings. Provide electronic trip unit where indicated on the Drawings, with adjustable functions as indicated on the Drawings.
- B. Circuit breakers shall have an interrupting rating of 65,000 amperes symmetrical at 480 VAC, unless otherwise indicated on the Drawings.
- C. Enclosed circuit breakers in non-hazardous locations shall be UL 489 Listed. Circuit breakers in hazardous locations shall be UL 1203 Listed.
- D. In non-hazardous locations, enclosed circuit breakers shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

<b>AREA DESIGNATION</b>	<b>ENCLOSURE TYPE AND MATERIAL</b>
Indoor Wet Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Process Area	NEMA 12, Painted Steel
Indoor Dry Non-process Area	NEMA 1, Painted Steel
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 304 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

- E. In hazardous locations, enclosed circuit breakers shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

<b>AREA CLASSIFICATION</b>	<b>ENCLOSURE TYPE AND MATERIAL</b>
Class 1, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class 1, Division 2, Group D	NEMA 7, Die Cast Aluminum
Class 2, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class 2, Division 2, Group F	NEMA 9, Die Cast Aluminum

- F. Enclosed circuit breakers shall be quick-make, quick-break and with an interlocked cover which cannot be opened when the breaker is in the "ON" position and capable of being locked in the "OPEN" position.
- G. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the enclosure.
- H. Enclosed circuit breakers shall be suitable for use as service entrance equipment and so labeled to suit the application.
- I. Where indicated on the Drawings, enclosed circuit breakers shall be 100% rated.

### **PART 3 – EXECUTION**

#### **3.01 INSTALLATION**

- A. The enclosed circuit breaker shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer.
- B. Enclosed circuit breakers shall be set true and plumb in locations as shown on the Drawings. The top of enclosure shall not exceed six (6) feet above finished floor elevation.
- C. Enclosed circuit breakers shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

#### **3.02 TESTING**

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests
  - a. None required
2. Field Tests
  - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.

- - END OF SECTION - -

SECTION 16496  
AUTOMATIC TRANSFER SWITCHES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, connect, test and place in satisfactory operation automatic transfer switches as specified herein and indicated in Drawings.
- B. The automatic transfer switch shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.
- C. Circuit breaker control and relaying/metering circuits shall be wired in accordance with the requirements specified herein or indicated on the Drawings.

1.02 CODES AND STANDARDS

- A. All equipment shall be listed by and shall bear the label of Underwriter's Laboratories, Incorporated, (U.L.).
- B. The equipment shall comply with the following codes and standards:
  - 1. National Electrical Code (NEC)
  - 2. Institute of Electrical and Electronic Engineers (IEEE)
    - a. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems.
  - 3. American National Standards Institute (ANSI):
    - a. C12.1 - Code for Electricity Metering
    - b. C39.1 - Electrical Analog Indicating Instruments
    - c. C57.13 - Instrument Transformers.
  - 4. National Electrical Manufacturer's Association (NEMA):
    - a. AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
    - b. ICS 10 – AC Transfer Switch Equipment
    - c. KS 1 - Enclosed Switches.

- d. PB 2 - Deadfront Distribution Switchboards.
- 5. Underwriters Laboratories, Inc. (U.L.):
  - a. U.L. 50 - Cabinets and Boxes.
  - b. U.L. 98 - Enclosed and Dead Front Switches.
  - c. U.L. 489 - Molded Case Circuit Breakers.
  - d. U.L. 891 - Dead-Front Switchboards.
  - e. U.L. 943 - Ground Fault Circuit Interrupters.
  - f. U.L. 977 – Fused Power Circuit Devices.
  - g. U.L. 1008 – Automatic Transfer Switches

#### 1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings
  - 2. Operation and Maintenance Manuals
  - 3. Spare Parts Lists
  - 4. Special Tools List
  - 5. Reports of certified shop tests shall be submitted which indicates a closing and withstand ampere rating as required based on short circuit study requirements. Rating shall be symmetrical, 3-cycle and/or 30-cycle at 480 VAC (as applicable).
  - 6. Copies of certified field test reports.
  - 7. Manufacturer's field start-up report.
  - 8. Manufacturer's Representative's certification.
  - 9. Guarantee/Warranty Program
- B. Each submittal shall be identified by the applicable specification section.

#### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete or illegible submittals will be returned to the Contractor for resubmittal without review.
- C. Shop drawings for each automatic transfer switch shall include but not be limited to:
  - 1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.
  - 2. Product data sheets.
  - 3. Complete assembly, layout, and installation drawings with clearly marked dimensions and conduit entrance locations.
  - 4. Example equipment nameplate data sheet.
  - 5. Complete internal schematic and interconnecting wiring diagrams. Standard wiring diagrams that are not custom created by the manufacturer for the automatic transfer switch for this project are not acceptable.
  - 6. Nameplate schedule.
  - 7. Manufacturer's installation instructions.
  - 8. Manufacturer's standard guarantee/warranty.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted. If standard data and catalog literature is supplied, all furnished options shall be carefully highlighted and options not being furnished shall be carefully deleted. Unclear information will cause rejection of the entire submittal.
- E. Prior to completion and final acceptance of the project, the Contractor shall furnish and install "as-built" wiring diagrams for each automatic transfer switch. These final drawings shall be plastic laminated and securely placed inside each transfer switch and included in the O&M manuals.

#### 1.05 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1. The manuals shall include:
  - 1. Instruction books, descriptive bulletins, technical bulletins, application data booklets, and other applicable instructional information.
  - 2. Recommended spare parts list.
  - 3. Final as-built construction drawings included in the shop drawings incorporating all changes made in the manufacturing process and field installation.

#### 1.06 TOOLS, SUPPLIES AND SPARE PARTS

- A. The automatic transfer switches shall be furnished with all special tools necessary to disassemble, service, repair and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.
- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the Work, at which time they shall be delivered to the Owner.
- D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

#### 1.07 IDENTIFICATION

- A. Each automatic transfer switch shall be identified with the identification number indicated on the Drawings (e.g. ATS-MDPS, etc.). A nameplate shall be securely affixed in a conspicuous place on each switch. Nameplates shall be as specified in Section 16195 – Electrical - Identification.

#### 1.08 WARRANTY

- A. The manufacturer shall warrant each automatic transfer switch against all materials and workmanship for a minimum of five (5) years from date of shipment. In addition, the manufacturer shall repair or replace equipment found faulty under the terms of the warranty. The manufacturer shall submit data outlining the guarantee/warranty program.



## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. The equipment described herein, as a minimum, shall meet all of the requirements specified in this Section and shall be a product of a manufacturer who has produced automatic transfer switches for a period of at least five (5) years. The equipment shall be compatible with the loads to be served. Assembly of the switches by a fabricator is not acceptable.
- C. The automatic transfer switches shall be power contactor style as manufactured by Cummins, Eaton, Siemens Energy and Automation Inc., General Electric equivalent, Automatic Switch Company equivalent, or equal.

### 2.02 AUTOMATIC TRANSFER SWITCH

- A. General - Power Contactor Type
  - 1. Switches shall have ampere ratings and number of poles as indicated on the Drawings and shall be suitable for 480 VAC, three-phase, 60 Hertz operation.
  - 2. For three phase, four-wire systems where a neutral is required, a true four-pole switch shall be supplied with all four electrically and mechanically identical poles mounted on a common shaft. The continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles.
  - 3. The switch shall be capable of switching all classes of load and rated for continuous duty when installed in a non ventilated enclosure.
  - 4. For switches with a continuous current rating of 100A or less, the three-cycle closing and withstand current rating of the switch shall be 30,000 amperes RMS (minimum). For switches with a continuous current rating greater than 100A and less than or equal to 600A, the three-cycle closing and withstand current rating of the switch shall be 65,000 amperes RMS (minimum). This rating may be obtained through the use of a specific coordinated circuit breaker supplying the automatic transfer switch. The Contractor shall coordinate the supply of this specific circuit breaker with the equipment suppliers. This specific circuit breaker shall be furnished and installed by the equipment supplier.
  - 5. This switch shall be complete with all accessories and listed by UL under Standard UL-1008 for use on emergency systems.
  - 6. All bolted bus connections shall have Belleville compression type washers. Switches for four-wire systems shall be furnished with a fully rated solid neutral bus.

7. The switch shall be equipped with 90°C rated copper/aluminum solderless mechanical type lugs of the proper quantity and size to accommodate the termination of field wiring.

B. Design Requirements - Power Contactor Type

1. The switch shall be double throw, actuated by two (2) electrical operators momentarily energized and connected to a simple over-center linkage. A center-off-position shall be provided as a neutral position during switching. Minimum transfer time shall be 400 milliseconds.
2. The switches shall be capable of transferring successfully in either direction with 70 percent of rated voltage applied to the terminals.
3. The time delay between the opening of the closed contacts and the closing of the open contacts shall allow for voltage decay before transfer, allowing the motor and transformer loads to be re-energized after transfer with normal in-rush current. Switches using in-phase monitors are not acceptable.
4. Normal and standby contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts to be of silver-tungsten alloy, mechanically locked in position in both the normal and standby positions without the use of hooks, latches, or magnets. Provide separate arcing contacts, with magnetic blowouts on each pole. Interlocked molded case circuit breakers, switches or contactors are not acceptable.
5. Equip the transfer switch with a permanently attached, safe, manual operator designed to prevent injury to personnel in the event the electrical operator should become energized during manual transfer. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from slowly switching the main contacts.

C. Sequence of Operation

1. Should the voltage on any phase of the normal source drop below 80 percent or increase to 120 percent, or frequency drops below 90 percent, or increase to 110 percent, or 20 percent voltage differential between phases occur, after a programmable time delay period, factory set at three (3) seconds to allow for momentary dips, the engine starting contact(s) shall close to start the standby generator.
2. Transfer to the standby power source shall occur when 90 percent of rated voltage and frequency has been reached by the standby power source.
3. After restoration of normal power on all phases to a preset value of 90 percent to 110 percent of rated voltage, at least 95 percent to 105 percent of rated frequency, and voltage differential is below 20 percent between phases, an adjustable time delay period, factory set at 300 seconds shall delay the transfer to allow stabilization of the normal source. Should the standby source fail during this time delay period, the switch shall automatically retransfer to the normal source.

4. After retransfer to the normal power source, the standby generator shall operate at no load for a programmable period, factory set at 300 seconds. Should the normal power source fail during this time delay period, the transfer switch shall automatically return to the standby source.

#### D. Controls

1. The transfer switch controller shall be a Model ATC-300+ IQ transfer device as manufactured by Eaton Corporation, or equal. The controller shall be programmed by the manufacturer at the factory.
2. The microprocessor-based control system shall provide all the operational functions of the automatic transfer switch. The controller shall include a LCD display with keypad, and shall display the following:
  - a. Connected Source and Load voltages on all phases
  - b. Connected Source and Load frequency
  - c. Condition Status (e.g. Under-voltage, Under-frequency)
  - d. Real time clock for Time/Date Stamp
  - e. Historical Data
  - f. Programming and set point information
  - g. Timer countdown for each timer while functioning
3. Controller shall be capable of communicating to the manufacturer's or the Owner's furnished remote supervisory control system via Modbus 485.
4. The controller shall have password protection to limit access to authorized personnel.
5. The controller shall include three-phase over/under voltage, over/under frequency, phase sequence detection, and phase differential monitoring on both normal and standby sources.
6. The controller shall be capable of storing the following records in memory for access either locally or remotely:
  - a. Engine run time.
  - b. Normal source available time.
  - c. Standby source available time.
  - d. Normal source connected time.
  - e. Standby source connected time.
  - f. Load energized time.
  - g. Number of Transfers.

- h. Date, time and reason for last sixteen (16) transfers.
- 7. The controller shall include individual LED's for indicating the following:
  - a. Switch is in normal position.
  - b. Switch is in standby position.
  - c. Controller is in Automatic Mode.
  - d. Controller is in Test Mode.
  - e. Availability of normal source.
  - f. Availability of standby source.
- 8. A digital LCD voltage readout, with 1% accuracy shall display phase-to-phase voltages for both the normal and standby source.
- 9. A digital LCD frequency readout with 1% accuracy shall display frequency for both the normal and standby source.
- 10. The microprocessor controller shall meet the following requirements:
  - a. Storage conditions - 25°C to 85°C
  - b. Operation conditions - 20°C to 70°C ambient
  - c. Humidity 0 to 99% relative humidity, non-condensing
  - d. Capable of withstanding infinite power interruptions
  - e. Surge withstand per ANSI/IEEE C-37.90A-1978
- 11. All control wiring shall be 18 gauge (minimum), 600 VAC, SIS switchboard type. All control wiring shall be identified at each termination (both ends) using tubular, sleeve-type wire markers.

#### E. Accessories

- 1. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.
- 2. Programmable three phase sensing of the standby source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.

3. Programmable time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation). Factory set at 3 seconds.
4. Programmable time delay on retransfer to normal source, factory set at 300 seconds.
5. Programmable time delay after retransfer to normal source, that allows the generator to run unloaded prior to shutdown, factory set at 300 seconds.
6. Programmable Time delay on transfer to standby source, factory set at 3 seconds.
7. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.
8. A time delay bypass on retransfer to normal shall be included. Keypad initiated.
9. Contact, rated 10 A at 30VDC, to close on failure of normal source to initiate engine starting.
10. A plant exerciser shall be provided with (10) 7 day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise the standby plant programmable in one minute increments. Also include a control switch for selection of either "no load" (switch will not transfer) or "load" (switch will transfer) during the exercise period. Keypad initiated.
11. Relay contacts which close when normal source fails wired to a terminal strip.
12. Relay contacts which open when normal source fails wired to a terminal strip.
13. Two auxiliary contacts rated 15 A at 120 VAC on main shaft, closed on normal and wired to a terminal strip.
14. Two auxiliary contacts rated 15 A at 120 VAC on main shaft, closed on standby and wired to a terminal strip.

## 2.03 ENCLOSURES

- A. Unless otherwise specified or indicated on the Drawings, the automatic transfer switch enclosures shall be NEMA 4X, Type 304 Stainless Steel, dead-front, with front accessibility. Furnish wall mounted or free standing enclosures as required. Furnish enclosures for both bottom and top entry of cables. Furnish the equipment so that rear access is not required for operations, maintenance, and repair tasks. Other enclosure requirements are:
  1. The color of the enclosure interior and back panel located within the enclosure shall be white.
  2. The enclosure shall be equipped with an internal, welded steel, door-mounted print pocket.
  3. Enclosures located outdoors shall be furnished with a thermostatically controlled space heater.

4. A steel hinged and padlockable cover shall be provided for a device panel.
5. A steel hinged and padlockable cover shall be provided for the controller.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

- A. Each automatic transfer switch shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.
- B. The automatic transfer switch shall be provided with adequate lifting means for installation of wall or floor mounted enclosures.
- C. The Contractor shall tighten all assembled bolted connections to the manufacturer's torque recommendations prior to energizing.
- D. Install each switch to allow complete door swing required for component removal. This is specifically required where a switch is set next to a wall to the left of the switch enclosure.

### 3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
  1. Witnessed Shop Tests
    - a. None Required.
  2. Certified Shop Tests and Reports
    - a. Automatic transfer switches shall be given routine factory tests. The factory tests shall demonstrate that the completed switches function correctly and that the required timing has been set. Certification of these settings shall be submitted to the Engineer upon request.
    - b. Test procedures shall be in accordance with the latest version of UL and NEMA standards.
    - c. The three and/or thirty cycle tests shall be performed without the use of current limiting fuses. During the 3-cycle and/or 30-cycle withstand tests, there shall be no contact welding or damage.
    - d. Oscillograph traces across the main contacts shall verify that contact separation has not occurred and there is contact continuity across all phases after completion of the test.
    - e. When conducting temperature rise tests in accordance with UL-1008, include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests.

- f. Manufacturer shall submit test reports upon request.

### 3. Field Tests

- a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000 Basic Electrical Requirements.
- b. Prior to acceptance of the installation, load test the equipment with all available motor loads, but do not exceed the nameplate rating of the automatic transfer switch. Correct defects which become evident during this test.

### 3.03 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the Contractor's personnel and the Owner's operating personnel in its maintenance and operation as outlined elsewhere in Division 1 and Section 11000, Equipment - General Provisions. The services of the manufacturer's representative shall be provided for a period of not less than as follows:
  - 1. One trip of one (1) working day during installation of the equipment for each automatic transfer switch.
  - 2. One trip of one (1) working day after acceptance of the equipment.
  - 3. One trip of one (1) working day during the warranty period.
- B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out on each day he is at the project.
- C. The manufacturer shall have an established network of service centers capable of servicing the specified equipment.
- D. Service center personnel shall be on call 24 hours a day, 365 days a year. Personnel shall be factory trained and certified in the maintenance and repair of the specified equipment.
- E. After warranty service contracts shall be made available to the Owner by the manufacturer, through the service centers, to provide periodic maintenance and/or repair of the specified equipment.

### 3.04 TRAINING

- A. The Contractor shall provide training for Owner personnel. Training shall be conducted by the manufacturer's factory trained specialists who shall instruct Owner personnel in operation and maintenance of all equipment provided under this Section. Training shall be in accordance with the requirements of Section 11000, Equipment-General Provisions.
- B. Provide the services of an experienced, factory trained technician or service engineer of the switch manufacturer at the jobsite for minimum of one (1) day for training of Owner personnel, beginning at a date mutually agreeable to the Contractor and the Owner. The

technician shall be on duty at the site for at least 8 hours per day and shall be available 24 hours per day when required to advise concerning special problems with equipment and systems.

### 3.05 PAINTING

- A. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same coating as used for factory finishing coats.

### 3.06 MANUFACTURER'S CERTIFICATION

- A. A qualified, factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.

- - END OF SECTION - -



## SECTION 16620

### PACKAGED ENGINE GENERATOR SYSTEMS

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install a standby power engine generator set complete with base-mounted fuel storage tank, leak detection systems, piping, exhaust silencer, batteries, charger, enclosure, and devices for automatic and manual control.
- B. It is the intent under this Contract to require an installation complete in every detail whether or not indicated on the Drawings or specified. Consequently, the Contractor is responsible for all details, devices, accessories and special construction necessary to properly install, adjust, test, and place in successful and continuous operation the engine-generator set.
- C. Use materials which are new, unused, and as specified, or, if not specifically indicated, the best and most suitable of their kinds for the purpose intended, and for the design and expected conditions of service, subject to the approval of the Engineer.
- D. Provide workmanship that is first class in every respect. Employ workers thoroughly experienced in such work. A neat and workmanlike appearance in the finished work shall be required.
- E. All materials used must bear the inspection labels of the Underwriter's Laboratories, if the material is of a class inspected by the Laboratory.
- F. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.
- G. The engine generator sets shall fully comply with all current Environmental Protection Agency (EPA) emission regulations including, but not limited to, the New Source Performance Standards (NSPS) for stationary and non-road generator sets. The engine generator set(s) must meet the EPA new source performance requirements required at the time the engine generator set(s) submittal is approved by the engineer. Engines manufactured previous to the submittal approval date that do not meet the current regulated emissions levels are not acceptable.
- H. Reference Section 16000, Basic Electrical Requirements and Section 16496, Automatic Transfer Switch.

## 1.02 CODES AND STANDARDS

- A. The packaged engine-generator system shall comply with the following Codes and Standards as a minimum:
1. NEMA MG1, Motors and Generators.
  2. NEMA MG2, Safety Standard for Construction and Guide for Selection, Installation and Use of Motors and Generators.
  3. ISO STD 8528, Reciprocating Internal Combustion Engines.
  4. ISO STD 3046, Performance Standard for Reciprocating Internal Combustion Engines.
  5. NFPA 30, Flammable and Combustible Liquids Code.
  6. NFPA 37, Standard for Installation and use of Stationary Combustible Engine and Gas Turbines.
  7. NFPA 70, National Electrical Code
  8. NFPA 70E, Standard for Electrical Safety in the Workplace
  9. NFPA 110, Standard for Emergency and Standby Power Systems.
  10. UL 508, Industrial Control Equipment.
  11. EGSA, Electrical Generating Systems Association.
  12. UL 2200 – Stationary Engine Generator Assemblies
  13. ANSI C57, Dry-Type Transformers.
  14. UL 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.

## 1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
1. Shop Drawings
  2. Spare Parts List
  3. Special Tools List
  4. Reports of Certified Shop and Field Tests
  5. Operation and Maintenance Manuals
  6. Manufacturer's Field Start-up Report
  7. Manufacturer's Representative's Installation Certification

- B. Each submittal shall be identified by the applicable specification section.

#### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.

- C. Shop drawings for each engine-generator set shall include but not be limited to:

1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this specification section.

2. Manufacturers printed specification sheets showing critical engine and generator set specifications including the following:

- Dimensions, and weights
- Guaranteed fuel consumption at 25%, 50%, 75% and 100% of full rated load
- Engine bhp available
- Brake Mean Effective Pressure (BMEP)
- Engine jacket water heat rejection
- Exhaust flow rate and temperature at 100% of rated load
- Ventilation and combustion air requirements
- Exhaust backpressure limitation
- Liquid refill capacities
- Voltage regulation characteristics
- Guaranteed noise levels

3. Alternator technical electrical data, including, but not limited to:

- Alternator efficiency at 50%, 75%, and 100% load
- Telephone Interference Factor (TIF)
- Harmonic waveform distortion
- Type of winding insulation and generator temperature rise

- Per unit subtransient impedance  $X''$  and X/R ratios for positive, negative, and zero sequences
  - Transient reactance ( $X_d'$ )
  - Synchronous reactance ( $X_d$ )
  - Sub transient time constant ( $T_d''$ )
  - Transient time constant ( $T_d$ )
  - DC time constant ( $T_{dc}$ )
  - Decrement curve
4. Manufacturer's printed warranty statement of the engine and generator set showing single source responsibility by the engine manufacturer.
  5. Generator control panel equipment and features. Include a written explanation of the auto start/stop logic and operation.
  6. Engine-generator set and accessory product data sheets including, but not limited to, the following:
    - Alternator strip heater
    - Radiator
    - Seismically rated vibration isolators
    - Flexible exhaust coupling
    - Exhaust silencer
    - Batteries
    - Battery charger
    - Engine manufacturers shutdown contactors
    - Jacket coolant heater
    - Fuel cooler
    - Fuel tank(s) and pump(s)
    - Fuel level devices
    - Output circuit breaker and trip unit
    - Conduit
    - Wire and Cable
    - Wiring Devices
    - Lighting
    - Panelboards/combination power unit
  7. Standard dealer preventative maintenance contract for review and possible adoption under a separate contract. Dealer must have existing contracts and personnel and contractual detailed performance information available.
  8. Normal operating ranges for systems temperature, pressure and speed.
  9. Manufacturer's part number for the engine and generator operation guide, parts book, service manual, warranty policy, and installation guide.

10. Location of other similar units.
  11. Phone numbers of twenty-four (24) hour products support contacts and locations.
  12. Drawing showing right hand, left hand, and top views of proposed assembly; battery rack, isolators, exhaust silencer, conduit stub up locations, and flexible fittings; wiring schematics, interconnection diagrams (point to point), and written description of engine generator controls and alarm circuits.
  13. Fuel system piping schematic.
  14. Control panel layout drawings and wiring diagrams.
  15. Drawings and specifications for base-mounted fuel storage tank with accessories.
  16. EPA Certificate of Conformity for Exhaust Emissions
  17. Detailed drawings showing plan, front, and side views as well as appropriate section views of the weatherproof, engine-generator enclosure. Include product data sheets for all appurtenances (e.g. exhaust fan, thermostat, lighting, switches, receptacles, combination power unit, etc.) to be furnished and installed in the enclosure. Drawings shall be of sufficient detail to assure proper installation by the Contractor.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

#### 1.05 REPORTS OF CERTIFIED SHOP AND FIELD TESTS

- A. Submit two (2) certified copies of all test reports. This includes all shop tests and field tests. Certified shop test reports for prototype engine-generator sets are unacceptable. The manufacturer's serial number for the actual engine-generator set furnished for this project shall appear on all test reports.

#### 1.06 OPERATION AND MAINTENANCE MANUALS

- A. Two (2) preliminary copies of Operation and Maintenance Manuals, prepared specifically for this Project, shall be furnished for each item of equipment furnished under this Contract. The preliminary manuals shall be provided to the Engineer not more than 10 days after the equipment arrives on the project site.
- B. The preliminary manuals shall be reviewed by the Engineer prior to the Contractor submitting final copies for distribution to the Owner. Following review of the preliminary copies of the Operation and Maintenance Manuals, one (1) copy will be returned to the Contractor with required revisions noted, or the acceptance of the Engineer noted.
- C. Manuals shall contain complete information in connection with assembly, operation, lubrication, adjustment, wiring diagrams and schematics, maintenance, and repair, including detailed parts lists with drawings or photographs identifying the parts. Manuals shall contain all information submitted as part of the shop drawing review process.

- D. Manuals furnished shall be assembled and bound in separate volumes, by major equipment items or trades, and properly indexed to facilitate locating any required information. In addition, manuals should be labeled in the front cover with the project, name, equipment description, and manufacturer contract information.
- E. Engineer and the Owner shall be the sole judge of the acceptability and completeness of the manuals and may reject any submittal for insufficient information included, incorrect references and/or the manner in which the material is assembled.
- F. Following the Engineer's review of the preliminary manuals, the Contractor shall submit five (5) paper copies and two (2) electronic copies of the final Operation and Maintenance Manuals to the Owner. The manuals shall reflect the required revisions noted during the Engineer's review of the preliminary documents, as well as any changes made during installation. Failure of the final manuals to reflect the required revisions noted by the Engineer as well as changes made during installation will result in the manuals being returned to the Contractor. Acceptable final Operation and Maintenance Manuals shall be provided not more than one (1) month after receipt of the Engineer's comments.

#### 1.07 TOOLS, SUPPLIES, AND SPARE PARTS

- A. The engine-generator systems shall be furnished with all special tools necessary to perform regular maintenance. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

In addition to the manufacturer recommended spare parts, the Contractor shall furnish the following spare parts for each engine-generator set:

<u>No. Required</u>	<u>Description</u>
1	Set of Fuel Oil Particulate Filters
1	Set of Air Filters
1	Set of Lube Oil Filters
1	Set of Fuel Oil/Water Separator Filters
1	Set of Coolant Filters

- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- D. Spare parts list, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.
- F. The dealer shall have sufficient parts inventory to maintain over-the-counter availability of at least 90% of any required part and 100% availability within 48 hours.

## 1.08 IDENTIFICATION

- A. Each engine-generator set shall be identified with the identification name/number indicated on the Drawings (e.g., Generator No. 1, Generator No. 2, etc.). A nameplate shall be securely affixed in a conspicuous place on the generator main circuit breaker or output termination box enclosure. Nameplates shall be as specified in Section 16195, Electrical - Identification.

## 1.09 WARRANTY TERMS

- A. The manufacturer's and Dealer's warranty shall in no event be for a period of less than two (2) years or one-thousand (1,000) hours of operation, whichever comes first, from date of delivery of equipment to the project site and shall include repair labor, travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, coolant, and other service items made unusable by the defect) used during the course of repair. Submittals received without written warranties as specified shall be rejected in their entirety.
- B. Provided warranty shall cover all equipment included in the scope of supply. This warranty shall include, but is not limited to, the following:
  - Engine-generator set and respective auxiliary equipment
  - All controls for the engine-generator set
- C. Batteries shall be provided with two (2) year full replacement guarantee, and a pro-rated replacement schedule thereafter.

## 1.10 OIL SAMPLING KIT

- A. The generator set supplier shall provide an oil sampling analysis kit which operating personnel shall utilize for scheduled oil sampling. All equipment needed to take oil samples shall be provided in a kit and shall include the following:

- 1 Sample extraction gun
- 10 Bottles
- 10 Postage-paid mailers
- 1 Written instructions

An additional oil sampling kit shall be made available to the Owner to continue the sampling when the above specified kit has been depleted. All kits in addition to that specified above shall be at an additional cost to the Owner, if the Owner desires to continue the sampling service.

## 1.11 CONSTRUCTION SEQUENCING

- A. The Contractor shall reference Section 01520, Maintenance of Utility Operations During Construction, of these Specifications.

## 1.12 PREVENTIVE MAINTENANCE AGREEMENT

- A. The engine/generator set supplier shall provide a preventive maintenance agreement using qualified factory trained service personnel, for a period of 2-year minimum. Provide all recommended fluids, dealer labor, travel labor and travel mileage to complete the suggested preventive maintenance as defined in the manufacturer's Operation and Maintenance Manual and as listed below. All parts shall be new and provided by the generator manufacturer. The maintenance agreement shall include the following as a minimum:
1. Check oil level, check oil pressure safety shutdown switches, complete an oil sample analysis, check oil pressure and gauges, and inspect the system for leaks. Change oil and oil filter if required.
  2. Check coolant level, inspect/replace cooling system hoses, check high/low temperature alarms and shutdowns, inspect radiator, inspect fan and fan belts (tighten or replace as required). Flush coolant system and replace coolant if required.
  3. Inspect the fuel system including fuel pumps and tank(s), check fuel pressure, inspect fuel filters and replace if required, and check for water in fuel storage tank.
  4. Check the battery and battery charging system including a voltage test, check and clean battery terminals, check and inspect engine starting system.
  5. Inspect and test the generator, check bearing grease and add grease if required, check terminations, and complete a generator winding insulation resistance (i.e. megger test).
  6. Check engine control system including overspeed alarms and shutdowns, overcrank alarm, engine starter, circuit breaker and fuses, and test and adjust engine governor.
  7. Check and the engine air intake and exhaust systems for leaks and damage. Check air filter and replace if required.
  8. Test automatic transfer switch. Check all indicating lights and replace as required.
  9. Inspect all components of the generator enclosure including, but not limited to, lights, louvers, fans, doors, etc.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. Consideration will be given only to the equipment of those manufacturers who have furnished comparable size diesel engine-generator sets for at least two similar installations that have been in regular successful operation for not less than five (5) years.
- C. The Contractor shall furnish evidence of this experience and data on the equipment's operation at these installations to the Engineer upon request.



- D. The engine-generator set manufacturers shall be Cummins or Generac. No substitutions shall be permitted. The engine-generator set manufacturer shall be responsible for the entire engine-generator package including the engine-generator set with enclosure, fuel system, piping, automatic transfer switch, accessories, electrical equipment, and other devices for a complete and operable system.

## 2.02 GENERAL DESCRIPTION

- A. The engine-generator set shall be rated as specified herein and as indicated on the Drawings. It shall have the capability to operate at its standby rating for the duration of any power outage with all accessories including engine running devices, silencer, radiator, cooling fans, fuel system, and all appurtenances complete as it would be installed in the field. The Contractor shall note and take appropriate action regarding the intended operation of the engine-generator sets while connected to motor driven loads controlled by variable frequency drives (VFDs).

## 2.03 ENGINE

- A. The engine shall be diesel, 4 Cylinder, 4 cycle, radiator cooled, and shall be turbocharged having an operating speed of 1800 RPM. Engine shall operate on No. 2 diesel fuel. Engines requiring premium fuels are not acceptable.
- B. The engine will not be acceptable if the design is a conversion of a naturally aspirated engine to which a turbo-blower has been attached, unless the engine is certified by the manufacturer as having been analyzed and redesigned with ample provisions for increased stresses and bearing or heat loads due to increased pressures and rate of heat liberation.
- C. Brake Horsepower (BHP), and Engine-Generator efficiency shall conform with ASME, IEEE and NEMA standards that electrical energy delivered by the machine is within the minimum certified guaranteed fuel oil consumption rate and evidence that these parameters have been met shall be furnished.
- D. Routine maintenance and adjustments shall be performed without the use of special tools or instruments. Only engine manufacturers' standard ratings shall be acceptable. No dealer special ratings will be acceptable.
- E. The specified standby kW rating shall be for continuous electrical service during interruption of the normal utility source, per NEMA standards. Prime rating shall also be included in the submittal.
- F. Engine speeds shall be governed by an electronic isochronous governor that will sense generator speed and provide accurate load transient correction capability at less than 0.5 percent regulation, from no load to full load generator output.
- G. The engine shall have a 12 volt battery charging generator with an automatic charge rate regulator. Starting shall be by a 12 volt electric starter.

## 2.04 ALTERNATOR

- A. The alternator shall conform with NEMA and IEEE standards rated as indicated on the Drawings. The alternator shall have a UL 2200 listing. The alternator shall be brushless, salient pole, 2/3 pole pitch and synchronous for operation at 480VAC, wye connected, as

indicated on the Drawings. The generator shall be capable of at least 68 SkVA at no more than 20% voltage drop.

- B. Laminations and windings shall be designed for minimum reactance, low voltage waveform distortion and maximum efficiency.
- C. Insulation shall be Class H, 125 degrees C rise according to NEMA standards. All windings and coils shall have an additional treatment of three (3) coats of varnish to prevent fungus growth.
- D. Radio interference suppression (both directions) shall be provided in accordance with NEMA and IEEE Standards.
- E. The alternator shall have a brushless, permanent magnet exciter. The exciter shall supply field excitation to maintain output with the alternator loaded to 300% of continuous rating for 10 seconds at rated power factor.
- F. Waveform deviation shall not exceed 5% from true sine wave. The transient response from no load to full load in one step of the engine-generator set shall not exceed a voltage dip of 35%, a frequency dip of 20%, and shall recover to complete steady state performance within 12 seconds for both voltage and frequency. The transient response from full load to no load in one step shall not exceed a voltage overshoot of 7% and shall recover to steady state performance within 3 seconds. These measurements shall be made by a light beam oscillograph recorder and shall be a result of testing the engine-generator set combination. Data on generator transient response measured on an electric motor driven generator will not be acceptable in the submittal information.
- G. The Telephone Influence Factor (TIF) shall be less than 50.
- H. The voltage regulator shall be an adjustable, solid-state, three-phase RMS sensing, volts/hertz type. Voltage regulation shall be a minimum of +/-0.25% from no load to continuous rating. The voltage regulator shall provide +/-10% voltage adjustment. The voltage regulator shall be Type SSR as manufactured by Basler or equal. The voltage regulator shall be located within the engine control panel.
- I. An alternator mounted strip heater shall be furnished and installed as part of the system. The strip heater shall be "ON" to prevent condensation when the engine generator set is not running.

## 2.05 CONTROLS

- A. Engine-generator monitoring and controls shall be mounted in a single NEMA 1 dust-tight enclosure. A suitable accessible terminal strip having all wires properly identified shall be furnished. The panel shall include a local engine failure alarm, a dry contact for remote "Generator System Failure" alarm indication, and engine starting control wire. The panel shall be mounted 4'-8" measured from the center of the panel to the equipment pad.
- B. The engine starting shall be automatic and shall include a starting motor, a cranking contactor, provisions for electrically operated fuel control, and protective devices for low oil pressure, high coolant temperature, low coolant level, and overspeed conditions.

- C. The automatic engine starting control shall operate from a single pole contact which closes for engine run and opens for engine stop. When the engine starts, starting control shall automatically disconnect cranking controls.
- D. The cranking disconnect means shall be electrically self-regulating to prevent rekranking for a definite time after source voltage has been reduced to a low value. If the engine fails to fire, or any safety device should operate while the engine is running, the engine shall be stopped immediately and the starting controls locked out requiring manual resetting.

Failure to start shall initiate an alarm signal that must be reset in order to have the alarm activated after normal power is restored. The "Failure to Start" signal shall be derived from a dry contact closure which is wired as part of a common "Generator System Failure" alarm.

- E. Starting control circuits shall be arranged so that cranking will commence immediately after the single pole contact closes. Four cranking cycles of 10 seconds "ON", 10 seconds "OFF" shall be provided.
- F. The automatic engine starting controls shall use industrial rated control type elements throughout, and controls shall have the capability to operate at 50% battery voltage. Indicating lamps, pushbuttons, selector switches, and other pilot devices shall be accessible and mounted on the control enclosure.
- G. A molded case generator/exciter field circuit breaker with shunt trip device shall be furnished and installed as part of the engine generator set. Shunt trip shall be activated upon engine-generator fault conditions.
- H. A molded case main line circuit breaker as specified herein and sized as indicated on the Drawings shall be installed as a load circuit interrupting and protection device in a NEMA 1 (gasketed) dust-tight enclosure. The circuit breaker shall be provided with adjustable long-time, short-time, and instantaneous settings. The circuit breaker shall contain an electronic trip unit with ground fault. It shall operate both manually for normal operation and automatically for protection against overload or short circuits. Generator/exciter field circuit breakers are not acceptable for this service.

The molded case circuit-breakers described above shall be manufactured and tested in accordance with U.L. and NEMA AB1 standards. Their interrupting rating shall be suitable for the available fault current. All electrical ratings shall be suitable for the application.

- I. The devices necessary for automatic starting shall be on the engine and in the engine control panel.
- J. Engine-generator monitoring and control shall be provided using a microprocessor based control panel complete with LCD displays. Engine-generator monitoring and control shall include, but not be limited to, the following:
  - 1. Engine oil pressure indicator
  - 2. Coolant temperature indicator
  - 3. Voltmeter
  - 4. Ammeter
  - 5. Phase selector switch

6. Running time meter
7. Frequency meter
8. High coolant temperature shutdown, signal light (red), and dry contact with reset
9. Low oil pressure shutdown, signal light (red), and dry contact with reset
10. Engine overspeed shutdown, signal light (red), and dry contact with reset
11. Engine overcranking protection with signal light (red) and dry contact with reset (after a cranking cycle of one minute, engine cranking shall stop)
12. Engine tried to start but failed signal light (amber)
13. Low coolant level signal light (red) and dry contact
14. Engine "Run" (green) and "Fail" (red) signal lights and dry contacts
15. Low coolant temperature signal light (red) and dry contact
16. Pre-high engine temperature indication and dry contact
17. Pre-low fuel indication and dry contact
18. Engine control mode switch (Run-Off-Auto)
19. Tachometer and engine speed (RPM) indicator
20. Emergency stop pushbutton
21. Generator voltage adjust potentiometer
22. Generator frequency adjust potentiometer
23. Indicator/display test switch
24. Panel lights with On/Off switch

Engine "run" and "pre low fuel level" contacts shall be separate, independent dry contacts for remote indication.

The remaining dry contacts listed above shall be normally closed (N.C.) and wired in series to provide a "Generator System Failure" alarm for remote indication.

## 2.06 ENGINE ACCESSORIES

- A. Furnish and install the engine with all accessory equipment and appurtenances which may be required for proper operation, including the following:
  1. Dry type air cleaner
  2. Engine driven lubricating oil pump
  3. Lubricating oil strainer

4. Lubricating oil filter, bypass type, with replaceable absorbent-type elements
5. Lubricating oil cooler, water cooled
6. Lubricating oil cooling circulator pump (may be integral with main oil pump)
7. Fuel oil transfer pump
8. Fuel oil strainer
9. Fuel oil filter, with replaceable absorbent-type elements
10. Fuel oil fuel/water separator
11. Electronic controlled fuel injection
12. Fuel oil injection valve assemblies
13. Electronic isochronous governor
14. Safety controls, providing automatic engine shut-down, including:
  - a. Overspeed control
  - b. Low oil pressure control
  - c. High coolant temperature control
  - d. Failure to start control
  - e. Low coolant level control
15. Radiator and cooling fan
16. Jacket water circulating pump
17. Thermostats
18. Water expansion tank
19. Exhaust manifold
20. Automatic battery starting system
21. Cold starting aid engine block heaters with all controls
22. Instrument panel mounted on the engine, complete with instruments, including:
  - a. Lubricating oil pressure gauge
  - b. Fuel oil pressure gauge
  - c. Coolant temperature indicator
  - d. Fuel level indicator

23. Radiator mounted fuel cooler to cool recirculated fuel before it is re-deposited into the fuel tank as recommended by the manufacturer.

## 2.07 MOUNTING

- A. Couple the engine and generator together through a flexible, non-backlash type, all metal coupling which overcomes all normal misalignment stresses and transmits full engine torque with ample safety factor. Also provide flexible connections for piping connections.

## 2.08 RADIATOR

- A. Provide a radiator manufactured of a non-corrosive material mounted on the engine. The radiator core shall be coated with a corrosion resistant coating. Corrosion resistant coating shall be a corrosion resistant baked phenolic coating or similar.
- B. Connect the radiator to the engine internal cooling system with flexible piping.
- C. The engine shall be cooled through a radiator sized to continuously maintain safe operation at full load and at 105°F outside ambient air with 50% ethylene glycol coolant. A blower type fan and low noise fan drive and controls shall be furnished. The fan and all rotating members and drive belts shall be guarded and meet OSHA standards. Proof of 105°F ambient temperature capability shall be required.
- D. The unit shall be provided with 50% ethylene glycol. Nalcool treatment shall also be added to the system in the proper proportion.
- E. Unit mounted thermal circulation type water heaters shall be furnished to maintain engine jacket water temperature as recommended by manufacturer in an ambient temperature of 30°F. The heaters shall be single phase, 60 hertz, 120 volt thermostatically controlled as manufactured by Watlow Industries, Chromalox, Kim Hotstart, or equal. Heater(s) shall be sized for the application.

## 2.09 ENGINE STARTING SYSTEM

- A. Provide an engine starting system complete with battery charger and batteries.
- B. The charger shall be an automatic battery charger, 10 A max, current limited,  $\pm 2\%$  voltage regulation,  $\pm 10\%$  line voltage variation, equalizing timer, DC voltmeter, and DC ammeter. Provide a 0-24 hour equalize timer and a Form C Dry Contact to indicate a low battery alarm condition. Charger shall be as manufactured by Charles Industries, Exide, LeMarche, or equal.
- C. Starting batteries shall be sealed, lead-acid typerated 12 volts having adequate capacity for rolling the engine for five (5), ten (10) second cycles without starting and operating the control devices in the generator panel. The batteries shall be mounted on a suitable non-corrosive rack and shall be Nife, Exide, Tudor, or equal. Batteries shall have battery cables with lugs and shall be provided with lugs for connection to the battery charger.

## 2.10 EXHAUST SILENCER

- A. Furnish and install an exhaust silencer mounted within or exterior to the generator enclosure dependent on generator size and manufacturer's standards. Silencers mounted outside the

generator enclosure shall be 316 stainless steel interior and exterior. The silencer system shall be designed, furnished, and installed to prevent moisture and condensation from corroding the silencer. Silencers mounted within the generator enclosure shall be insulated using a calcium silicate material covered by a brushed aluminum skin. All exterior components of the exhaust silencer system shall be of 316 stainless steel. The work shall result in a long-term, aesthetically pleasing installation.

- B. Silencers shall be of critical type and sized to produce a high degree of silencing. Reference the sound attenuation requirements specified herein.
- C. Connect the silencer to the engine exhaust manifold with a high corrosion and temperature resistant stainless steel flexible convoluted exhaust pipe. Use flange-type connections. Provide a taper-cut tail pipe complete with rain cap to exhaust the gases to the atmosphere.
- D. The exhaust manifold, exhaust piping, and expansion fittings including collector box, shall be completely covered with an insulation blanket in order to protect operating personnel and to reduce noise. Insulation shall be of composite fiberglass and stainless steel construction capable of withstanding 1200°F continuously. The insulation blankets shall be tailored and custom fabricated to fit the contours of the manifolds. Average weight of the insulating blanket shall be 1.5 psf. Insulation shall conform to MIL-1-16411D, Type II and shall be custom fabricated to fit the contours of the manifold. Insulation shall be Hitco Blanket Armco, Hitco Blanket Insulation system, or equal.

## 2.11 WIRING

- A. Furnish and set in position internal wiring in the engine-generator set under this Section. All external wiring between the generator and engine-generator control panel, the automatic transfer switch and all other components of the standby power system, including conduit and connection, shall be provided.

## 2.12 AUTOMATIC TRANSFER SWITCH

- A. Furnish and install an automatic transfer switch as indicated on the Drawings and specified in Section 16496, Automatic Transfer Switch. The switch and its operation shall be considered to be part of the standby generator system.

## 2.13 BASE MOUNTED FUEL TANK

- A. The generator set shall be supplied with a U.L.-142 listed base mounted fuel tank of sufficient capacity to operate the engine-generator set at full load for a minimum of 24 hours. The tank, painted in a color as selected by the Engineer, shall be fabricated from steel with a rupture basin and leak detector system. The alarm and indicator for the leak detection shall be mounted adjacent to the generator control panel and a contact for remote indication of a fuel leak condition shall be provided. This contact shall be wired as part of a common "Generator System Failure" alarm.
- B. A level device shall also be furnished and installed to provide a local (generator control panel) and remote indication of pre-low fuel tank level and low fuel tank level. The pre-low fuel tank level shall activate a set of dry contacts for remote alarm indication. The low fuel tank level alarm shall shut down the engine to prevent the fuel level from dropping below the fuel pickup piping in the fuel tank. The pre-low fuel level alarm shall activate when only 6 hours of fuel for full load operation remains in the fuel tank. The remote low fuel tank level alarm shall be wired separate from the "Generator System Failure" alarm.

- C. The tank shall be supplied with all necessary fuel supply, return, vent, and fill fittings and a fuel level gauge. The lockable fill port and level gauge shall be easily accessible from outside the enclosure. The vent line shall be piped to the outside and be equipped with a fill whistle.
- D. The system shall be equipped with a radiator mounted fuel cooler, which shall remove all heat added to fuel in the recirculation process at a 105°F ambient.
- E. The underside of the tank shall not be in contact with the mounting surface (concrete pad).

## 2.14 WEATHERPROOF ENGINE - GENERATOR ENCLOSURE

- A. Furnish and install an outdoor, weather-protective housing. The housing shall be furnished complete with a full sub-base floor resulting in complete enclosure. The enclosure shall be factory-assembled to the engine-generator set base and radiator cowling. Lifting eyes shall be provided. Housing shall provide ample airflow for generator set operation. The housing shall be constructed of 12 gauge (minimum) aluminum or 14 gauge (minimum) galvanized steel, reinforced to be vibration free in the operating mode. The housing shall have hinged side-access doors and rear control panel access door. Each door shall have at least two latch-bearing points. All doors shall be lockable. All steel sheet metal shall be primed for corrosion protection and finish painted in a color as selected by the Owner. Roof shall be peaked to allow drainage of rain water. Unit shall have sufficient guards to prevent entrance by small animals. Batteries shall fit inside enclosure and alongside the engine (batteries under the generator are not acceptable). Unit shall have engine coolant and oil drains outside the unit to facilitate maintenance. Each drain line shall have a high quality valve located near the fluid source.
- B. A "Skin-tight" housing shall be provided. No walk-around access is required within the enclosure.
- C. Enclosure shall be sound attenuated to provide sound level as specified herein.
- D. Conduit and wire shall be in accordance with Sections 16111 and 16123, respectively.
- E. The weather-proof engine-generator enclosure shall be manufactured by Chillicothe Metal Company, Pritchard-Brown, Atkinson, Tramount or equal.

## 2.15 SOUND ATTENUATION

- A. Extreme care shall be exercised in providing equipment for and setting the engine-generator in place to guard against excessive noise transmission and vibrations. Fasten to the underside of the skids seismically-rated spring type isolators.
- B. The engine-generator enclosure shall be designed, furnished, and installed to reduce source noise to 78 dB(A) as measured at seven (7) meters from the enclosure.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

- A. The standby generator system shall be furnished and installed as indicated on the Drawings and as recommended by the equipment manufacturer.



- B. The initial filling of the fuel storage tank shall be provided by the Contractor. Fuel tank shall be filled to its full capacity. At the conclusion of all field testing, the Contractor shall fill the fuel storage tank back to its full capacity. Fuel shall be ultra-low sulfur diesel in accordance with ASTM D-975. Fuel shall be new and free from contaminants and water.

### 3.02 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall provide the services of a qualified generator manufacturer's factory-trained technical representative who shall adequately supervise the installation and of all equipment furnished under this Contract. The manufacturer's representative shall certify in writing that the equipment has been installed in accordance with the manufacturer's recommendations. No further testing or equipment startup may take place until this certification is accepted by the Owner.
- B. The manufacturer's technical representative shall perform all startup and field testing of the generator assembly as specified herein.
- C. The Contractor shall provide training for the Owner's personnel. Training shall be conducted by the manufacturer's factory-trained representative who shall instruct Owner's personnel in operation and maintenance of all equipment provided under this Section. Training shall be provided for two (2) sessions of four (4) hours each. Training shall not take place until after the generator has been installed and tested. Training shall be conducted at times coordinated with the Owner.
- D. The services of the manufacturer's representative shall be provided for a period of not less than as follows:
  - 1. One (1) trip of one (1) working day during installation of the engine-generator set.
  - 2. One (1) trip of one (1) working day to perform startup of the engine-generator set.
  - 3. One (1) trip of one (1) working day to perform the field testing of the engine-generator set.
  - 4. One (1) trip of one (1) working day to perform training as specified herein.
- E. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

### 3.03 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
  - 1. Witnessed Shop Tests
    - a. None required.
  - 2. Certified Shop Tests
    - a. Fully test the engine-generator set with all accessories in the manufacturer's plant before shipment. Tests shall be conducted through the use of balanced, three-phase, dry-type, resistive load banks.

- b. Record complete test data for frequency, amperes, volts, power factor, exhaust temperature, coolant temperature, and oil pressure.
- c. The manufacturer shall conduct a shop test run of at least six (6) consecutive hours for the set under the following conditions of load, in the following order:

- 2 hours - full load
- 1 hour - 3/4 load
- 1 hour - 1/2 load
- 1 hour - 1/4 load
- 1 hour - no load

- d. Fuel, lubricants, and other fluids as required for the shop tests shall be furnished by the manufacturer.

### 3. Field Tests

- a. Field tests shall be performed by the generator manufacturer's technical representative. The Contractor shall obtain from the manufacturer and submit a detailed field test plan and procedures documenting the intended field test program.
- b. In the presence of the Engineer and Owner, the representative shall inspect, adjust, and test the entire system after installation and leave in good working order. Field tests specific to each generator shall be conducted after the entire engine-generator system is installed including, but not limited to, the following: diesel fuel tanks including leak detection, exhaust silencer, radiators, enclosures, batteries, and all other equipment included in the complete system.
- c. Field test the generator enclosure to ensure the enclosure performs as specified herein. The generator enclosure field tests shall include water tests to confirm the enclosure does not leak and that the air intake louvers eliminate water intrusion to the interior of the generator enclosure when the generator is operating at its full load capacity (maximum airflow). A garden hose shall be used to simulate falling rain for this test. Water supply and garden hose will be provided by the Owner for this test.
- d. Field test, as far as practicable, all control, shutdown, and alarm circuits. Document the successful completion of these tests as witnessed by the Owner and the Engineer.
- e. Generator load tests shall be conducted through the use of balanced, three-phase, dry-type, reactive (0.8 power factor) load banks. Conduct a continuous run test using the load bank without shutdown for the engine-generator set under the following load conditions (in this specific order) and in the presence of the Owner and Engineer:

- 4 hours, full load
- 1 hour, 3/4 load
- 1 hour, 1/2 load
- 1 hour, 1/4 load
- 1 hour, no load

Record complete test data for frequency, amperes, volts, power factor, exhaust temperature, coolant temperature, and oil pressure every 15 minutes during the continuous run test. If any failures, malfunctions, and/or shutdowns occur during this test, the problems shall be fixed and the test shall be restarted. The test shall not be considered complete until the generator has operated for eight (8) consecutive hours without any shutdowns under the conditions listed above.

- f. After successful completion of the load bank tests, the generator system shall then be operated for a minimum of four (4) hours with plant loads during a time period when the plant is operating at average demand. The same data shall be recorded at 15 minute intervals for this load test as for the load bank test.
- g. The Contractor shall collect a sample of engine oil from each engine for analysis after the start-up and testing has been completed. The sampling method shall be of the atomic absorption spectrophotometry method and be accurate to within a fraction of one part per million for the following elements:
  - Iron
  - Chromium
  - Copper
  - Aluminum
  - Silicon
  - Lead

The sample shall also be tested for the presence of water, fuel dilution, and coolant.

The oil samples shall be analyzed at the generator set Manufacturer's facility by factory trained personnel. Independent laboratories not a part of the engine supplier's facility are disallowed as to conformance with this specification. Immediate notification of critical results shall be provided to the Owner when the analysis shows any critical reading.

- h. All fuel, lubricants, and other fluids required to complete all field tests shall be paid for by the Contractor.

### 3.04 PAINTING

- A. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same coating as used for factory finishing coats.

- - END OF SECTION - -



SECTION 16902  
ELECTRIC CONTROLS AND RELAYS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in satisfactory operation all electric controls and relays as specified herein and indicated on the Drawings.
- B. Electrical control and relay systems shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.
- C. Reference Section 16000, Basic Electrical Requirements and Section 16195, Electrical Identification.

1.02 CODES AND STANDARDS

- A. Products specified herein shall be in conformance with or listed to the following standards as applicable:
  - 1. NEMA 250 – Enclosures for Electrical Equipment
  - 2. UL 508A – Standard for Industrial Control Panels
  - 3. UL-1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.
  - 4. ANSI/ISA 12.12.01-2013 – Nonincendive Electrical Equipment for use in Class I and II, Division II Hazardous (Classified) locations.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings
  - 2. Spare Parts List
- B. Each submittal shall be identified by the applicable specification section.

#### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
  - 1. Product data sheets.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

#### 1.05 SPARE PARTS

- A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. In addition to the manufacturer recommended spare parts, the following spare parts shall be provided for the local control stations:
  - 1. One (1) contact block of each type furnished on the project
  - 2. One (1) indicating light lens of each color furnished on the project
  - 3. One (1) LED lamp of each color furnished on the project
- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- E. Parts shall be completely identified with a numerical system to facilitate parts control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same part number.

### PART 2 – PRODUCTS

#### 2.01 CONTROL COMPONENTS

- A. Manufacturers

1. Control components shall be manufactured by Eaton, The Square D Company, General Electric, Allen-Bradley, Siemens Energy and Automation, or Engineer approved equal.

## B. Pilot Devices

### 1. General

- a. All pilot devices shall be provided with a legend plate. Legend plates shall have a white background and black lettering and indicate the function of the respective pilot device. The text shown on the Drawings or indicated in the specifications shall be used as the basis for legend plate engraving (i.e. HAND-OFF-AUTO, RUN, EMERGENCY STOP, etc).
- b. All pilot devices shall be selected and properly installed to maintain the NEMA 250 rating of the enclosure in which they are installed. All pilot devices shall be UL 508 Listed.
- c. All pilot devices shall be 30.5mm in diameter, unless otherwise indicated. 22mm devices are not acceptable.
- d. Pilot devices for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.
- e. In Class 1 Division 2 hazardous locations, pilot devices shall be the hermetically-sealed type, constructed in accordance with ANSI/ISA 12.12.01.

### 2. Pushbuttons

- a. Pushbuttons shall be non-illuminated, black in color, and have momentary style operation unless otherwise indicated on the Drawings.
- b. Pushbuttons shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each pushbutton. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.
- c. Pushbuttons shall be provided with a full guard around the perimeter of the button. Where a lockout style pushbutton is specified or indicated on the Drawings, provide a padlockable guard.

### 3. Selector Switches

- a. Selector switches shall be non-illuminated, black in color, and have the number of maintained positions as indicated on the Drawings and as required. Handles shall be the extended type that provide a greater surface area for operation.
- b. Selector switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally

closed contact shall be installed at each selector switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

- c. Where indicated in the Drawings or Specifications, provide spring return positions.
- d. Selector switches shall be provided with an indexing component that fits into the keyed portion of the cutout for the device and prevents the switch from spinning when operated.

#### 4. Indicating Lights

- a. Indicating lights shall LED type, with the proper voltage rating to suit the application, and push-to-test feature.
- b. Indicating light lens colors shall be as required in equipment specifications and/or as indicated on the Drawings. If lens colors are not indicated, the following colors shall be used:

Red	-	"Run", "On", "Open"
Green	-	"Off", "Closed"
Amber	-	"Alarm", "Fail"
White	-	"Control Power On"

#### 5. Emergency Stop and Tagline Switches

- a. Emergency stop switches shall be non-illuminated, red in color, with a minimum 35mm diameter mushroom head. Once activated, switch shall maintain its position and require a manual pull to release/reset.
- b. Tagline switches shall have a plunger that activates upon tension from the associated safety cable. Once activated, switch shall maintain its position and require a manual release/reset.
- c. Emergency stop and tagline switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

### C. Relays and Timers

#### 1. General

- a. Relays and timers shall be furnished with an integral pilot light for positive indication of coil energization.
- b. Relays and timers shall have tubular pin style terminals with matching 11-pin DIN rail mount socket. Spade or blade style terminals are not acceptable.



- c. Relays and timers for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.
- 2. Control and Pilot Relays
  - a. Miniature or "ice-cube" type relays are not acceptable.
  - b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.
  - c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have 3-pole, double-throw (3PDT) contact arrangement.
- 3. Time Delay Relays
  - a. Timers delay relays shall utilize electronic timing technology. Mechanical timing devices are not acceptable.
  - b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.
  - c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have double-pole double-throw (DPDT) contact arrangement.
  - d. Time delay ranges shall be as indicated on the Drawings and/or as required to suit the application. Timing range shall be adjustable from the front of the relay. On delay and off delay timer configurations shall be provided as indicated on the Drawings and/or as required to suit the application.
- 4. Elapsed Time Meters
  - a. Elapsed time meters shall be non-resettable type with no less than a 4 digit display. Coil voltage shall be as required to suit the application and/or as indicated on the Drawings.
- D. Control Terminal Blocks
  - 1. Control terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or subpanel. Terminals shall be tubular screw type with pressure plate that will accommodate wire size range of #22 - #8 AWG.
  - 2. Control terminal blocks shall be single tier with a minimum rating of 600 volts and 20A. Separate terminal strips shall be provided for each type of control used (i.e. 120VAC vs. 24VDC). Quantity of terminals shall be provided as required to suit the application. In addition, there shall be a sufficient quantity of terminals for the termination of all spare conductors.

3. Terminals shall be marked with a permanent, continuous marking strip, with each terminal numbered. One side of each terminal shall be reserved exclusively for incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

## 2.02 LOCAL CONTROL STATIONS

- A. Local control stations shall be furnished and installed complete with pushbuttons, selector switches, indicating lights, and other devices as indicated on the Drawings.
- B. Specific devices installed in local control stations shall be provided in accordance with the requirements specified elsewhere in this Section.
- C. In non-hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Process Area	NEMA 12, Die Cast Zinc
Indoor Dry Non-process Area	NEMA 12, Die Cast Zinc
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass or Thermoplastic Polyester
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 304 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

- D. In hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	ENCLOSURE TYPE AND MATERIAL
Class 1, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class 1, Division 2, Group D	NEMA 4X, Type 304 Stainless Steel
Class 2, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class 2, Division 2, Group F	NEMA 9, Die Cast Aluminum

- E. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs. Conduit hubs shall be external to the enclosure.
- F. Local control stations for use in non-hazardous locations shall be UL-508 Listed. Local control stations for use in Class 1 Division 1 and Class 2 Divisions 1/2 hazardous locations shall be UL-1203 Listed. Local control stations for use in Class 1 Division 2 hazardous locations shall be in accordance with ANSI/ISA 12.12.01-2013.
- G. Provide a nameplate on each local control station in accordance with Section 16195, Electrical Identification. The name and/or number of the equipment associated with each control station shall be engraved on the nameplate, followed by the words "LOCAL CONTROL STATION".

## PART 3 – EXECUTION

### 3.01 INSTALLATION

- A. Local control stations shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.
- B. All control components shall be mounted in a manner that will permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component's mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices.
- C. Pilot devices shall be properly bonded to the equipment enclosure door where they are installed. If proper bonding cannot be achieved through the locknuts that affix the device in place, a green colored bonding screw shall be provided on the pilot device. The bonding screw shall be bonded to the equipment enclosure through the use of an insulated green bonding conductor.
- D. Local control station covers shall be bonded to the local control station enclosure through the use of an insulated green bonding conductor.
- E. Wiring to devices at each local control station shall be provided with enough slack to permit the local control station cover to be removed and pulled at least 6 inches away from the enclosure.
- F. Terminal strips, relays, timers, and similar devices shall not be installed on the rear of the panel/cabinet doors. Terminal strips, relays, timers, and similar devices shall not be installed on the side walls of panel/cabinet interiors without written permission from the Engineer.

- - END OF SECTION - -



SECTION 17138  
AUTOMATIC ALARM DIALER

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the automatic alarm dialers with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 TOOLS, SUPPLIES, AND SPARE PARTS

NONE

PART 2 – PRODUCTS

2.01 AUTOMATIC ALARM DIALER

- A. An automatic alarm dialer shall be a completely automatic alarm reporting unit utilizing digitally recorded and stored human voice messages to notify personnel over standard dial-up, subscriber type telephone lines. The unit shall be suitable for a 120 volt, single phase, 60 Hz power supply. The dialer shall be provided in a NEMA 4X enclosure.
- B. The dialer shall be a microprocessor-based system capable of sensing at least 8 alarm conditions from either normally open or normally closed field contacts. Power failure shall be sensed internally by the unit.
- C. Upon detection of any of the alarm conditions by the change of state of a field contact, or power failure, the unit shall, after a programmable time delay, begin dialing the first of at least 16 user-programmable telephone numbers. It shall then deliver a message describing the alarm condition in a digitally recorded human voice.
- D. The unit shall continue to call the phone numbers programmed in succession until an acknowledgement is received in the form of a specific touch-tone key or calling the unit back. Once acknowledged, the unit shall enter a programmable delay period to allow correction of the alarm condition before beginning notification again. If a new alarm occurs in this delay period, the unit shall abort the delay and begin its calling sequence.
- E. The alarm dialing unit shall be provided with the following physical and functional characteristics.
- Integral battery back-up, at least 16 hours.
  - Tone and pulse-dialing capabilities.

- Visual indications of the following conditions:
    - Power Status
    - Time and Date
    - Alarm Conditions
    - Battery Condition
    - Operating Mode
  - Integral surge protection on all power, phone, and signal inputs.
  - Remote programming capability for all phone signal inputs.
  - Built-in microphone to allow audio monitoring of the site and two-way conversations.
  - Programmable time-of-day operation.
  - Independent programmable time delay for each alarm condition.
- F. The dialing alarm unit shall be FCC registered for direct connection to a standard dial-up, subscriber type line and shall be furnished complete with all necessary power and telephone connection cords.
- G. The automatic alarm dialer shall be manufactured by Raco, Antx, Inc., Phonetics Inc., or equal.

### PART 3 – EXECUTION

#### 3.01 REQUIREMENTS

- A. The Automatic Alarm Dialer shall be installed at the location shown on the Drawings.
- B. Following is a list of alarms and initiating sources for the dialer:

<b>Alarm</b>	<b>Signal Source</b>
Generator Running	Generator Control
Generator Failure	Generator controls
High Water Level	Level switch relay panel

- - END OF SECTION - -

SECTION 17500  
ENCLOSURES, GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the control enclosures, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.
- B. Control enclosures shall be assembled, wired, and tested in the instrumentation subcontractor's own facilities, unless specified otherwise. All components and all necessary accessories such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips that may be required to complete the system shall be provided.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17560 – Transient Voltage Surge Suppression Devices
- B. Refer to Division 16 for additional requirements for cable, circuit breakers, disconnect switches, etc.

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. The cabinet itself and all interior and exterior equipment shall be identified with nameplates. The equipment shall be mounted such that service can occur without removal of other equipment. Face mounted equipment shall be flush or semi-flush mounted with flat black escutcheons. All equipment shall be accessible such that adjustments can be made while the equipment is in service and operating. All enclosures shall fit within the allocated space as shown on the Drawings.
- B. Either manufacturer-standard or custom cabinetry may be furnished subject to the requirements of the Contract Documents and favorable review by the Owner.
- C. Due consideration shall be given to installation requirements for enclosures in new and existing structures. The Contractor shall examine plans and/or field inspect new and existing structures as required to determine installation requirements, and shall coordinate the installation of all enclosures with the Owner and all affected contractors. The Contractor shall be responsible for all costs associated with installation of enclosures, including repair of damage to structures (incidental, accidental or unavoidable).

1.04 TOOLS, SUPPLIES AND SPARE PARTS

- A. In addition, the spare parts items shall be provided as specified in the individual cabinet and panel specification sections.

## PART 2 – PRODUCTS

### 2.01 TERMINAL BLOCKS

- A. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the cabinet subpanel. Terminals shall be of the screw down pressure plate type as manufactured by Phoenix Contact, Wieland, Square D, or equal.
- B. Power terminal blocks shall be single tier with a minimum rating of 600 volts, 30 amps.
- C. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20 amps.

## PART 3 – EXECUTION

### 3.01 FABRICATION

- A. Enclosures shall provide mounting for power supplies, control equipment, input/output subsystems, panel mounted equipment and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.
- B. Enclosures shall be sized to adequately dissipate heat generated by equipment mounted inside the panel. If required, one or more of the following shall be provided to facilitate cooling:
  - 1. Louvered openings near the bottom and top (NEMA 12 cabinets only).
  - 2. Thermostatically controlled, low noise internal air blowers (initial setpoint 75°F) to circulate air within the enclosure, maintaining a uniform internal temperature.
  - 3. Thermostatically controlled, low-noise cooling fans to circulate outside air into the enclosure, exhausting through louvers near the top of the cabinet (NEMA 12 cabinets only). Air velocities through the enclosure shall be minimized to assure quiet operation.
  - 4. All openings in cabinets and panels shall be fitted with dust filters.
- C. Enclosures shall be constructed so that no screws or bolt heads are visible when viewed from the front. Punch cutouts for instruments and other devices shall be cut, punched, or drilled and smoothly finished with rounded edges.
- D. The temperature inside each enclosure containing digital hardware (i.e., cabinet, panel or console) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature.
- E. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Engineer, a vendor's pre-engineered and prefabricated wiring termination system will be acceptable.



- F. Wiring shall comply with accepted standard instrumentation and electrical practices. Power, control and signal wiring shall comply with Division 16 of the specifications. For each pair of parallel terminal blocks, the field wiring shall be between the blocks.
- G. Separate terminal strips shall be provided for each type of power and signal used within each cabinet.
- H. All wiring shall be bundled and run open or enclosed in vented plastic wireway as required. Wireways shall be oversized by a minimum of 10%; overfilled wireways shall not be acceptable. All conductors run open shall be bundled and bound at regular intervals, not exceeding 12 inches, with nylon cable ties. Care shall be taken to separate electronic signal, discrete signal, and power wiring.
- I. A copper 120 VAC ground bus shall be installed in each cabinet, and shall be connected to the building power ground. A separate, isolated copper ground bus shall be installed in each cabinet for the logic (24 VDC) ground. Both ground buses shall be clearly labeled as to voltage and function.
- J. Interior panel wiring and field wiring shall be tagged at all terminations with machine-printed plastic sleeves. The wire numbering system and identification tags shall be as specified in Section 16123 - Building Wire and Cable. Where applicable, the wire number shall be the ID number listed in the input/output schedules. Wires shall be color coded as follows:

Equipment Ground - GREEN

120 VAC Power - BLACK

120 VAC Power Neutral - WHITE

120 VAC Control (Internally Powered) - RED

120 VAC Control (Externally Powered) - YELLOW

24 VAC Control - ORANGE

DC Power (+) - RED

DC Power (-) - BLACK

DC Control - BLUE

Analog Signal - BLACK/WHITE or BLACK/RED

- K. Enclosures shall be provided with a main circuit breaker and a circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that an overload in a branch circuit will trip only the branch breaker but not the main breaker.
- L. Enclosures with any dimension larger than 36 inches shall be provided with 120-volt duplex receptacles for service equipment and fluorescent service lights. Power to these devices shall be independent from the PLC power supply and its associated uninterruptible power system.
- M. Where applicable, enclosures shall be furnished with red laminated plastic warning signs in each section. The sign shall be inscribed "WARNING - This Device Is Connected to Multiple Sources of Power". Letters in the word "WARNING" shall be 0.75 inch high, white.

- N. The interconnection between equipment and panel shall be by means of flexible cables provided to permit withdrawal of the equipment from the cabinet without disconnecting the plugs.

### 3.02 PAINTING

- A. All steel enclosures shall be free from dirt, grease, and burrs and shall be treated with a phosphatizing metal conditioner before painting. All surfaces shall be filled, sanded, and finish coated by spraying a 1-2 mil epoxy prime coat and smooth, level, high grade textured finish between flat and semi-gloss shine. The colors shall be selected by the Owner from a minimum of six color samples provided. Refer to Division 9 for additional requirements.
- B. Materials and techniques shall be of types specifically designed to produce a finish of superior quality with respect to adherence, as well as impact and corrosion resistance.
- C. Panels fabricated from stainless steel shall not be painted.

### 3.03 INSTALLATION

- A. Refer to Section 17000 for additional requirements.

- - END OF SECTION - -

SECTION 17560  
SURGE PROTECTION DEVICES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install and place in satisfactory operation the surge protection devices (SPDs) as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17500 – Enclosures, General

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. All surge protectors of each type provided under this Contract shall be furnished by a single manufacturer.

PART 2 – PRODUCTS

2.01 ELECTRICAL TRANSIENT PROTECTION, GENERAL

- A. All electrical and electronic elements shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and nearby electrical systems.
- B. Manufacturer's Requirements: All surge protection devices shall be manufactured by a company that has been engaged in the design, development, and manufacture of such devices for at least 5 years. Acceptable manufacturers shall be Phoenix Contact, Edco, Transtector, or equal.
- C. Surge protection device installations shall comply with UL 94, the National Electric Code (NEC), and all applicable local codes.
- D. Surge protection devices shall be installed as close to the equipment to be protected as practically possible.
- E. Device Locations: As a minimum, provide surge protection devices at the following locations:
  - 1. At any connections between ac power and electrical and electronic equipment, including panels, assemblies, and field mounted analog transmitters.
  - 2. At both ends of all analog signal circuits that have any portion of the circuit extending outside of a protecting building.
  - 3. At both ends of all copper-based communications cables which extend outside of a building, including at field instruments and the field side of analog valve position signals.

4. On all external telephone communications lines.

## 2.02 AC POWER PROTECTION

### A. Surge protection device assemblies for connections to AC power supply circuits shall:

1. Be provided with two 3-terminal barrier terminal strips capable of accepting No. 12 AWG solids or stranded copper wire. One terminal strip shall be located on each end of the unit.
2. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements. The surge protection device shall be provided with provisions for mounting to interior of equipment racks, cabinets, or to the exterior of freestanding equipment.
3. Be constructed as multistage devices consisting of gas tube arrestors, high energy metal oxide varistors, or silicon avalanche suppression diodes. Assemblies shall automatically recover from surge events, and shall have status indication lights.
4. Comply with all requirements of UL 1449, second edition.
5. Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.
6. Have the following characteristics:
  - a. Maximum Continuous Operating Voltage: 150VAC
  - b. Maximum Operating Current: 20 amps
  - c. Ambient Temperature Range: -20 degrees C to +65 degrees C
  - d. Response Time: 5 nanoseconds

## 2.03 ANALOG SIGNAL CIRCUIT PROTECTION

### A. Surge protection device assemblies for analog signal circuits shall:

1. Have four lead devices with a threaded mounting/grounding stud or DIN Rail mounting.
2. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.
3. Be constructed as multistage devices consisting of gas tube arrestors and silicon avalanche suppression diodes. Gas tube arrestors and diodes shall be separated by a series impedance of no more than 20 ohms. Assemblies shall automatically recover from surge events.
4. Comply with all requirements of UL 497B.

5. Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.
6. Limit line-to-line voltage to 40 volts on 24VDC circuits.
7. Have the following characteristics:
  - a. Maximum Continuous Operating Voltage: 28VDC
  - b. Ambient Temperature Range: -20 degrees C to +65 degrees C
  - c. Response Time (Line-to-Line): 5 ns

#### 2.04 COMMUNICATION CIRCUIT PROTECTION

- A. Surge protection devices for copper-based data communication circuits shall:
  1. Be designed for the specific data communication media and protocol to be protected (i.e. telephone, serial, parallel, network, data highway, coax, twinaxial, twisted pair, RF, etc.).
  2. Provide protection of equipment to within the equipment's surge withstand levels for applicable standard test wave forms of the following standards:
    - a. IEC 60-1 / DIN VDE 0432 part 2
    - b. CCITT K17 / DIN VDE 0845 part 2
    - c. IEEE C62.31
  3. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.
  4. Provide automatic recovery.

### PART 3 – EXECUTION

#### 3.01 REQUIREMENTS

- A. Refer to Section 17500 for additional requirements.

- - END OF SECTION - -



## SECTION 17670

### LEVEL SWITCHES (SUSPENDED FLOAT TYPE)

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the float level switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

#### PART 2 – PRODUCTS

##### 2.01 LEVEL SWITCHES (SUSPENDED FLOAT TYPE)

- A. Level switches of the direct acting float operated design shall be comprised of a hermetically sealed, approximately 5 inch diameter plastic casing float, containing microswitches and flexibly supported by means of a heavy neoprene or PVC jacket, with three conductor cable a minimum of 20 feet in length. Unless otherwise specified, media specific gravity is 0.95 to 1.05. Microswitches shall be one normally open and one normally closed, 5A 115V AC capacity. Float hangers and supports shall be provided as shown on the installation detail drawings. Float switches shall be Model ENM as manufactured by Flygt, or equal.

#### PART 3 – EXECUTION

##### 3.01 INSTALLATION

- A. Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Drawings and Shop Drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Division.
- B. Field equipment shall be wall mounted or mounted on two inch diameter pipe stands welded to a 10 inch square 1/2 inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2 inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
- C. Embedded pipe supports and sleeves shall be Schedule 40, Type 316 stainless steel pipe, ASA B 36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.
- D. Materials for miscellaneous mounting brackets and supports shall be 316 stainless steel construction.

- E. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the specifications.

### 3.02 ADJUSTMENT AND CLEANING

- A. The instrumentation subcontractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his designated representative(s), reserves the right to witness any test, inspection, calibration or start up activity. Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.
- B. The instrumentation subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.
- C. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation and control system.
- D. Field instrument calibration requirements shall conform to the following:
  - 1. The instrumentation subcontractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
  - 2. Each instrument shall be calibrated at 0, 25, 50, 75 and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy's as set forth by the National Institute for Standards and Technology (NIST).
  - 3. The instrumentation subcontractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.
  - 4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.



5. Upon completion of calibration, devices shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.

- - END OF SECTION - -

